Department of Electronics and Communication Engineering
Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research and technological service to the National needs.

Institute Mission

1. To educate students at Undergraduate, Post Graduate Doctoral and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
2. To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
3. To develop effective teaching and learning skills and state of art research potential of the faculty.
4. To build national capabilities in technology, education and research in emerging areas.
5. To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

Department Vision

To become a centre of excellence in teaching and research for creating technical manpower to meet the technological needs of the country in the field of Electronics and Communications Engineering.

Department Mission

1. To facilitate state of the art Education and Research at Undergraduate, Post Graduate and Doctoral levels to enable to perform challenging engineering and managerial jobs in the field of Electronics and Communication Engineering.
2. To build national capabilities in Technology, Education and Research in emerging areas in the field of Electronics and Communication Engineering.
3. To create an environment to provide excellent Research and Development facilities to strengthen Ph.D. programmes and Research Projects.
4. To provide excellent Technological Services to bridge the gap between Academics and Industry in order to fulfil the overall academic needs of the society.
5. To provide high quality Course Structure in order to turn out qualified professionals to meet the engineering needs of the country.
6. To develop effective Teaching Skills and the Research Potentials of the faculty members.
7. To ensure All Round Development of the students and to create a platform for turning out engineering professionals who can assume leadership position in society.

M. Tech. (Instrumentation Engineering)

PEO (Programme Educational Objectives)

PEO1 To enable students to acquire in-depth knowledge in the field of Instrumentation Engineering with an ability to integrate existing and new knowledge with the advancement of the technology.

PEO2 To develop students to critically analyze the problems in the field of Instrumentation Engineering and find optimal solution.

PEO3 To train students to conduct research and experiments by applying appropriate techniques and tools with an understanding of the limitations for sustainable development of society.

PEO4 To prepare students to act as a member and leader of the team to contribute positively to manage projects efficiently in the field of Instrumentation Engineering.

PEO5 To train students to effectively communicate, write reports, create documentation and make presentations by adhering to appropriate standards.

PEO6 To stimulate students for life-long learning with enthusiasm and commitment to improve knowledge and competence continuously.

PROGRAM OUTCOMES (POs)

After completion of the programme, students will be able to

PO1 Independently carry out research /investigation and development work to solve practical problems.

PO2 Write and present a substantial technical report/document.

PO3 Demonstrate the degree of mastery in Instrumentation Engineering at a level higher than the requirements in the appropriate bachelor program.

PO4 Recognize the need for continuous learning and to prepare themselves to create, select and apply appropriate techniques and tools to undertake activities in the field of Instrumentation Engineering with an understanding of the limitations.

PO5 Demonstrate professional and intellectual integrity, professional code of conduct, and ethics of research with an understanding of responsibility to contribute in the field of Instrumentation Engineering for sustainable development of society.

PO6 Possess knowledge and understanding of engineering with management principles to apply the same as a member or leader in a team to carry out research work/projects efficiently in the field of Instrumentation and other multidisciplinary areas.

COURSE INFORMATION SHEET

Course code: EC518
Course title: Advanced Instrumentation System
Pre-requisite(s): B.E./B.Tech. in ECE/EEE/CS with basic courses on DSP
Co- requisite(s): Electronics Instrumentation
Credits: L:3 T:0 P:0 C: 3
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	Explain the concept of intelligent instrumentation and impart knowledge on automation.
2.	Develop an ability to model and analyze a real time system.
3.	Develop an ability to evaluate the performance of a Automation system.
4.	To select a particular controller based on the requirement of the system
5.	Develop an ability to design an intelligent system for industrial automation.

Course Outcomes:

After the completion of this course, students will be:

CO1	Demonstrate on the understanding of automation and functioning of various elements in a real time system.
CO2	Have an ability to identify and analyze various components of an automation system.
CO3	Have an ability to evaluate the performance of PLC.
CO4	Have an ability to develop a virtual instrumentation system.
CO5	Communicate the instrumentation signal using HART protocol

SYLLABUS

EC518 ADVANCED INSTRUMENTATION SYSTEM

Module I: Review of transducer, Introduction about Instrumentation system. Types of Instrumentation system. Data acquisition system and its uses in intelligent Instrumentation system. Detail study of each block involved in making of DAS, Signal conditioners as DA, IA, signal converters (ADC), Sample and hold. Designing application for Pressure, Temperature measurement system using DAS. Data logger. (8 L)

Module 2: Introduction about Automation system. Concepts of Control Schemes, Types of Controllers. Components involved in implementation of Automation system i.e., DAS, DOS, Converter (I to P) and Actuators: Pneumatic cylinder, Relay, solenoid (Final Control Element), Computer Supervisory Control System, Direct Digital Control's Structure and Software. SCADA- Remote terminal units, Master station, Communication architectures and Open SCADA protocols. DCS- Evolution of Different architecture, Local unit, Operator Interface, Displays, Engineering interface, factors to be considered in selecting DCS, case studies in DCS. (8 L)

Module 3: PLC: PLC architecture, PLC operation, Addressing modes of PLC, Languages used in PLC Programming, Instructions used in Ladder programming, Programming examples of different processes. (8 L)

Module 4: Virtual Instrumentation- Introduction to LabVIEW, Block diagram and architecture of a virtual instrumentation, Graphical programming in data flow, comparison with conventional programming, Vis and sub-Vis, loops and charts, arrays, clusters and graph, case and sequence structures, formula nodes, local and global variables, string and file I/O. (8 L)

Module 5: Introduction about Intelligent controllers, Model based controllers, Predictive control, Artificial Intelligent Based Systems, Experts Controller, Fuzzy Logic System and Controller, Artificial Neural Networks, Neuro-Fuzzy Control system. Case study. Introduction to telemetry, Instrument interfacing, Current loop, RS232/485, Field bus, Modbus, GPIB, USB Protocol, HART communication Protocol- Communication modes and networks. (8 L)

Text Book

1. Computer Based Industrial Control – By Krishna Kant, PHI
2. Process Control Instrumentation – By Curtis D. Johnson, Pearson Education

Reference Book

1. "Principle of Industrial Instrumentation" By D. Patranabis, TMH publications

2. National Instruments LabVIEW manual.

3. High performance Instrumentation and Automation, CRC Press, Taylor & Francis Group, 2005

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

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

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC520
Course title: Advanced Sensing Techniques
Pre-requisite(s): B.E./B. Tech. in ECE/EEE/CS with basic courses on DSP
Co- requisite(s):
Credits: L:3 T:0 P:0 C: 3
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:
This course enables the students to:

1.	Describe the operation of various smart sensors and their application
2.	Select an appropriate sensor for a given application
3.	Compare analogue and digital transducer.
4.	Mathematically model a smart sensor
5.	Discuss the latest technology in sensor development

Course Outcomes:
After the completion of this course, students will be:

CO1	Understand the principle of operation of different sensors and their applications
CO2	Be updated on the recent trends in sensor technologies.
CO3	Design a wireless sensor network
CO4	Apply the concept of wireless sensor for weather monitoring
CO5	Solve design and modelling issue using complex engineering mathematics

SYLLABUS

EC 520 ADVANCED SENSING TECHNIQUES

Module I:
Introduction to smart sensors, Principles of operation, design approach, interface design, configuration supports. (8 L)

Module 2:
Introduction, Electro-chemical Cell, Cell potential, Sd. Hydrogen Electrode (SHE), Liquid Junction and Other potentials, Polarization, Reference Electrodes, Sensor Electrodes, Electro-Ceramics in Gas Media. Analyzers for different gas and laboratory testing of chemicals. (8 L)

Module 3:
MEMS sensor, Comparison between MEMS and Macro sensor, Fabrication and packaging issue in sensor design Thick film and thin film technique Physical sensors. Bio sensor, Silicon sensor, RF Sensor, sensors for robotics. (8 L)

Module 4:
Wireless Sensor, principle and working, wireless sensing network, protocols used, Application of wireless sensor for weather monitoring. (8 L)

Module 5:
Design and modelling issue in advanced sensing technique. Introduction of different mathematical tools used in sensor design. Optimization techniques used in sensor design. The role of PCA, LDA, Neural network in designing sensor array. (8 L)

Text Book

1. Sensors and Transducers, by D. Patranabis. 2nd Edition
2. Electrical & Electronics Measurements and Instrumentation by A.K Sawhney, Dhanpat Rai & Sons.
3. Transducers and Instrumentation, by Murthy D. V. S., Prentice Hall, 2nd Edition, 2011

Reference Book

1. Sensor and signal conditioning by John G. Webster, Wiley Inter Science,2nd edition, 2008

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

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

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

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	2	2	1
CO3	3	3	2	3	2	1
CO4	2	3	2	2	2	2
CO5	3	2	3	3	3	2

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC522
Course title: Advanced Digital Signal Processing
Pre-requisite(s): B.E. /B. Tech. in ECE/EEE with basic courses on Digital Signal Processing
Co- requisite(s):
Credits: L: 3 T: 0 P: 0 C: **3**
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:
This course enables the students to:

1.	To understand the concept of signals and systems and filters.
2.	To impart knowledge on various transformation techniques.
3.	To impart knowledge on multirate signal processing and its applications.
4.	An understanding on optimum linear filters and power spectral estimation.
5.	Enhance skills to apply the filter design and spectral estimation in various applications.

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

CO1	Develop an understanding to concept of signals and systems and to design filters.
CO2	Have an ability to analyze and apply various single and multi-domain transformation techniques.
CO3	Have an ability to apply multirate signal processing on various engineering applications.
CO4	Develop an ability to apply use optimum linear filters and power spectral estimation.
CO5	Aspire for pursuing a carrier in signal processing, robotics and IOT, recognize the need to learn and adapt to the change in technology and play role of team leader or supporter of team.

SYLLABUS

EC 522 ADVANCED DIGITAL SIGNAL PROCESSING

Module I:
Review of Signals and Systems, Sampling and data reconstruction processes, Z transforms. Chirp Z Algorithm, Goertzel's Algorithm, Discrete linear systems, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters,IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures. (8 L)

Module 2:
DSP Transforms: Fourier transform, Discrete sine and cosine transform, Discrete Hartely transform, short time Fourier transform, wavelet transform, Hilbert transform, Hilbert-Huang transform, Stockwell transform. (8 L)

Module 3:
Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Multi resolution signal analysis, wavelet decomposition, Applications in subband coding. (8 L)

Module 4:
Linear prediction and Optimum Linear Filters: Random signals and power spectra, Forward and backward Linear prediction, solutions of the normal equations, AR lattice and ARMA lattice-ladder filters, Wiener filters. (8 L)

Module 5:
Power spectrum estimation: Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigenanalysis Algorithms for Spectrum Estimation. (8 L)

Text Book:

1. J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007. (T1)
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
3. S. Haykin and T. Kailath, Adaptive Filter Theory, Pearson Education, 4th Edition, 2005.

Reference Book:

1. Digital Signal Processing 3/E by S.K.Mitra TMH Edition.
2. Fundamentals of adaptive filtering, A. H. Sayed, Wiley, 2003.
3. Monson H. Hayes, Statistical Digital Signal Processing and Modelling, Wiley, 2002

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

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

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC524
Course title: Measurements and Statistics
Pre-requisite(s): Electronic Measurements
Co- requisite(s):
Credits: L: 3 T: 0 P: 0 C: **3**
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:

This course enables students to

1.	Understand basic statistics, and develop proficiency in the application of statistical tools and digital data acquisition and spectral analysis of data
2.	Understand basic electronics and circuit analysis for filters, amplifiers, and other signal conditioning circuits and be able to build such circuits
3.	Understand how various kinds of analog and digital sensors and instruments work,
4.	Understand how analog and digital sensors are calibrated – both statically and dynamically, and how they are applied in engineering
5.	Advance proficiency in professional communications and interactions

Course Outcomes

On the completion of this course, the students will be able to:

CO1	Apply statistical analysis to data samples to calculate mean, standard deviation, etc. and to determine the accuracy, precision, and sensitivity of sensors and instruments and statistical and error analyses to measured data to identify and remove outliers and predict uncertainties.
CO2	Apply linear and nonlinear regression analysis to perform curve fits to data and to determine correlation of variables and trends and also Create histograms and probability density functions (PDFs) of data samples,
CO3	demonstrate the ability to compare the results to standard PDFs such as the Gaussian and student's t PDFs, and demonstrate the ability to predict probabilities based on the PDFs
CO4	Apply differential equation analysis of first- and second-order dynamic systems to predict the behavior of sensors and instruments
CO5	Predict, analyze, and test the performance of sensors of various kinds, including strain gages, thermocouples, tachometers, displacement transducers, dynamometers, pressure gages and transducers, laser and Doppler velocimeters, pressure probes, and flow-meters

SYLLABUS

EC 524 MEASUREMENTS AND STATISTICS

Module I:

Introduction to mechanical engineering measurements – purpose, dimensions and units, significant digits; Dimensional analysis - primary dimensions, method of repeating variables; Review of basic electronics and circuits; Errors and uncertainties - bias and precision error, accuracy, calibration; Basic statistics – mean, standard deviation, variance, median, mode, etc , Histograms; Probability density functions; The normal (Gaussian) distribution, Central limit theorem; Other PDF distributions - lognormal, student's t, chi-squared; Correlation and regression analysis (least-squares curve fits). (8 L)

Module 2:

Outliers - single variables and data pairs; Experimental uncertainty analysis - RSS uncertainty; Experimental design - full vs. fractional factorial tests, Taguchi design arrays, RSM - Response surface methodology - an efficient way to hunt for an optimum result; Hypothesis testing - how to use statistics to make decisions, Digital data acquisition - introduction to digital data, A/D conversion, discrete sampling, clipping, aliasing; Signal reconstruction - the Cardinal series; Spectral analysis - introduction to Fourier series, harmonic amplitude plots; Fourier transforms - introduction to Fourier transforms, DFTs and FFTs. (8 L)

Module 3:

FFTs (continued) - Windowing - a technique to reduce leakage in FFTs; How to analyze the frequency content of a signal, Filters - first-order low-pass filter, first-order high-pass filter, other filters, Operational amplifiers (Op-Amps) - introduction and some circuits in which op-amps are used; Clipping circuits and examples, common-mode rejection ratio, gain-bandwidth product. (8 L)

Module 4:

Stress, strain, and strain gages - review of stress and strain, Hooke's law; Description of strain gages and how to use them; Wheatstone bridge circuits, and how they are used to measure strain, dynamic system response - dynamic measuring systems, zero-, first-, and second-order systems, Temperature measurement - types of temperature measurement including mechanical, thermoresistive, thermojunctive, and radiative methods. (8 L)

Module 5:

Mechanical measurements - mechanical measuring devices, such as potentiometers, linear variable displacement transducers, ultrasonic transducers, capacitance diplacement sensors, accelerometers, tachometers, and dynamometers, Fluid flow measurements - pressure, velocity, and volume flow rate measurements, Fluid flow measurements. (8 L)

Text Book:

1. http://www.mne.psu.edu/cimbala/me345/

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

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

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC525
Course title: HIGH FREQUENCY MEASUREMENT
Pre-requisite(s): Electromagnetic Filed Theory
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:
This course enables the students to:

1.	Understand various oscilloscope probes, current probes, Probe ground lead effects, wiggly scope patterns, ground loading,
2.	Understand probe compensation, compensation and waveform distortion, Differential measurements and probe correction techniques
3.	Understand Magnetic Pickup loops and related parameters, related theories, effect and application.
4.	Study current probes theory and uses for current probes limitations, Magnetic core saturation
5.	Study the measurement of pulsed EMI effects on Electronic circuits

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

CO1	Gain the knowledge of various oscilloscope probes, current probes, Probe ground lead effects, wiggly scope patterns, ground loading
CO2	Explain probe compensation, compensation and waveform distortion, Differential measurements,.
CO3	Explain Magnetic Pickup loops and related parameters, related theories, effect and practical applications
CO4	Gain the knowledge of current probes theory and uses for current probes limitations, Magnetic core saturation
CO5	Measure the pulsed EMI effects on Electronic circuits

SYLLABUS

EC 525 HIGH FREQUENCY MEASUREMENT

Module I:
Oscilloscope probes: types, Passive and Active oscilloscope probes, current probes, current probe specification, current probe electric field response, simple signal generator,
Probe ground lead effects, lead inductance, lead inductance and probe response, probe type with improved response, tell-tale signs of probe resonance, Wiggly scope patterns, Ground lead common impedance induced error, The null experiment, ground loading, use of ferrite on probes, More wiggly scope patterns. (8 L)

Module 2:
High Frequency passive probe compensation, Probe compensation, compensation and measurement frequency response, compensation and waveform distortion, compensation adjustment, compensation adjustment location, when to compensate, probe compensation effects
Differential measurements, need of differential measurements, advantages of differential measurements, available options for differential measurements, FET differential probes, two hi-Z 10X passive probe using A-B, balance coaxial probe, probe correction techniques.
(8 L)

Module 3:
Magnetic loop and other noncontact measurements, Square magnetic pickup loop- theory of operation, factors affecting size and shape of pickup loop, orientation of loop, current response of the pickup loop, pickup loop null experiments, effect of the pickup loop on circuit operation, Pickup loop technique of locating noise sources, other non-contact measurements. (8 L)

Module 4:
Current probes theory and uses, DC coupled, AC Coupled, Theory of operation, uses for current probes, limitations and Magnetic core saturation. (8 L)

Module 5:
Measurement of pulsed EMI effects on Electronic circuits: introduction, Technical background, inductive and capacitive coupling, the skin effect, and Measurement pitfalts, realistic options for system level pulsed. (8 L)

Text Book:

1. High Frequency Measurements and Noise in Electronic Circuit. Douglas C. Smith, Kluwer Academic Publishers, 1992
2. Noise in High-Frequency Circuits and Oscillators, Burkhard Schiek, Heinz-Jürgen Siweris, Ilona Rolfes, Wiley-Interscience, A john Wiley & sons inc. pub., 2006

Reference Book:

1. High-Frequency Circuit Design and Measurements, Peter C. L. Yip, Chapman & Hall, Delhi

Course Evaluation:
Individual assignment, Theory (Quiz and End semester) examinations

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

Topics beyond syllabus/Advanced topics/Design: PO6

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

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

< 34% = 1, 34-66% = 2, > 66% = 3

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: EE 549
Course title: Control system Design
Pre-requisite(s): Fundamentals of Mathematics and Physics, Introduction to System Theory, Control Theory
Co- requisite(s): Linear Algebra
Credits: L T P
3 0 0
Class schedule per week: 3
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	To state the performance characteristics of control systems with specific design requirements and design objectives;
2.	To understand the concepts of PD, PI, PID, lead, lag and lag lead controller design in time domain and frequency domain and apply it to specific real time numerical problems;
3.	To apply the state feedback controller and observer design techniques to modern control problems and analyse the effects on transient and frequency domain response;
4.	To realize and then design digital and analog compensators;
5.	Design controller for any type of linear plants

Course Outcomes:

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

CO1	Identify the design objectives and requirements of control systems;
CO2	Interpret the concepts of PD, PI, PID, lead, lag, lag lead, and discrete data controller design and apply it to solve some design problems;
CO3	Apply the state feedback controller design and techniques and outline its effects on system's performance which includes transient response and robustness;
CO4	To develop methodologies to design real time digital and analog compensatorsand reproduce the results and write effective reports suitable for quality journal and conference publications;
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

Module I:

Performance characteristics of feedback control system & design specification of control loop. Different types of control system applications and their functional requirement. Derivation of load-locus (toque/ speed characteristics of load). Selection of motors, sensors, drives. Choice of design domain & general guidelines for choice of domain. Controller configuration and choice of controller configuration for specific design requirement. Fundamental principles of control system design. Experimental evaluation of system dynamics in time domain and frequency domain (8 L)

Module II:

Design with PD Controller: Time domain interpretation of PD controller, frequency domain interpretation of PD controller, summary of the effects of PD controller. Design with PI controller: Time domain interpretation of PI controller frequency domain interpretation of PI controller, summary of the effects of PI controller, design with PID controller, Ziegler Nichols tuning & other methods (8 L)

Module III:

Design with lag/lead/lag-lead compensator, time domain interpretation of lag/lead/lag-lead compensator, frequency domain interpretation of lag/lead/lag-lead compensator, summary of the effects of lag/lead/lag-lead compensator. Forward & feed-forward controller, minor loop feedback control, concept of robust design for control system, pole-zero cancellation design. (8 L)

Module IV:

Sate feedback control, pole placement design through state feedback, state feedback with integral control, design full order and reduced order state observer. (8 L)

Module V:

Design of Discrete Data Control System: Digital implementation of analog controller (PID) and lag-lead controllers, Design of discrete data control systems in frequency domain and Z plane. (8L)

Text Books:

1. B.C. Kuo, "Automatic Control System", 7th Edition PHI. (T1)
2. M. Gopal, "Control Systems Principles & Design", 2nd Edition, TMH. (T2)
3. J.G. Truxal, "Automatic Feedback Control System", McGraw Hill, New York. (T3)
4. K. Ogata, "Discrete Time Control Systems", 2nd Edition, Pearson Education. (T4)

Reference Books:

1. Norman Nise, "Control System Engineering", 4th Edition. (R1)

2. M. Gopal, "Digital Control & State Variable Method", TMH. (R2)
3. B.C. Kuo, "Digital Control System", 2nd Edition, Oxford. (R3)
4. Stephanie, "Design of Feedback Control Systems", 4^{th} Edition, Oxford. (R4)

Course Evaluation:
Individual assignment, Theory (Quiz and End semester) examinations

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

(1) Real time analog design of controllers.
(2) Interfacing the controllers with the real time physical plants to identify the effects on system's performance. **PO5 & PO6**

Topics beyond syllabus/Advanced topics/Design

Advanced robust design methods for different control problems

COURSE DELIVERY METHODS

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Mini projects/Projects
CD4	Laboratory experiments/teaching aids
CD5	Self- learning such as use of NPTEL materials and internets
CD6	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC526
Course title: Digital Image Processing Techniques
Pre-requisite(s): B.E./B.Tech. in ECE/EEE/CS with basic courses on DSP
Co- requisite(s): Linear Algebra, Probability Theory
Credits: L:3 T:0 P:0
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:
This course enables the students to:

1	Gain an understanding on digital image formation, characteristics and its processing steps.
2	Demonstrate the use of different spatial and frequency domain processing techniques to improve the image quality.
3	Apply various segmentation techniques of an image.
4	Analyse various image description and representation methods for computer vision applications.
5	Demonstrate various techniques and its applications in object recognition and classification.

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

CO1	Develop an understanding on the image formation, pixel characteristics and processing step.
CO2	Have an ability to analyze the image quality using transformed and spatial domain filters.
CO3	Gain ability to segment and represent the image for computer vision tasks.
CO4	Apply and analyse various techniques for object recognition and classification task.
CO5	Develop an ability to create and apply the image processing techniques in various applications in many areas, recognize the need to learn, to engage and to adapt in a world of constantly changing technology.

SYLLABUS

EC 526 DIGITAL IMAGE PROCESSING TECHNIQUES

Module I:
Digital Image Fundamentals:
Fundamental steps in Digital Image Processing, Components of an Image processing system, DigitalImage Representation, Basic relationship between pixels, Basic Arithmetic/Logic operations on image: Image subtraction, Image averaging, Color image processing fundamentals: Color Modules, RGB, HIS, Lab colormodules, Convolution and Correlation theorems. (8 L)

Module 2:
Image Enhancement in Spatial and Frequency Domain:
Gray Level Transformations, Histogram Processing, Smoothing and Sharpening with Spatial Domain Filters, Fourier Transform, Fast Fourier Transform, Discrete Cosine Transform, Wavelet Transforms, Smoothing and Sharpening with Frequency Domain filters, Homomorphic filtering, Pseudo Color Image Enhancement. (8 L)

Module 3:
Image Restoration:
Noise Models, Restoration in the presence of Noise-Only Spatial filtering, Mean filters, Adaptivefilters Periodic Noise Reduction by Frequency Domain filtering , Inverse Filtering , Minimum Mean Square Error (Wiener) Filtering, Geometric Mean Filter. (8 L)

Module 4:
Image Segmentation and Representation:
Detection of Discontinuities, Point Detection, Line detection, Edge Detection, Thresholding , Optimal Global and Adaptive thresholding, Region-based Segmentation, Textural Images, Textural Featureextraction from Co-occurrence matrices, Chain codes, Signatures, Boundary Segments, Skeletons, Boundary Descriptors, Regional Descriptors. (8 L)

Module 5:
Object Recognition and Interpretation:
Elements of Image analysis, Pattern Classifier, Minimum distance classifier, Baye's Classifier, Neural Network algorithm, Fuzzy classifier, structural methods. (8 L)

Text Book

1. Digital Image Processing. 2/E by Rafael C. Gonzalez and Richard E. Woods. Pearson Education
2. Digital Image Processing and Analysis. by B. Chanda and D. Dutta Mujumdar PHI

Reference Book

1. Fundamentals of Digital Image Processing. By Anil K. Jain, PHI Publication
2. Image Processing, Analysis and Machine Vision. Milan Sonka and Vaclav Hlavac,

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

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

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC527
Course title: Speech Processing & Recognition
Pre-requisite(s): Digital Signal Processing
Co- requisite(s):
Credits: L: 3 T: 0 P: 0 C: **3**
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives

This course enables the students:

1	To explain fundamentals of speech production, its perception and inherent features.
2	To develop an ability to analyse parameter estimation and feature representations of speech signals.
3	To develop an ability to evaluate the pattern comparison and design issues of speech recognition.
4	To develop the concept and utilization of statistical and pattern recognition models.
5	To develop and apply different classifiers and features for different real life applications.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Demonstrate the understanding on the speech production, its perception and features.
CO2	Analyse various components of parameter estimation and feature representations of speech signals.
CO3	Illustrate various models for speech synthesis and automatic recognition.
CO4	Analyse the speech recognition and implementation issues.
CO5	Develop an ability to create and apply the speech recognition techniques in various applications in different areas.

SYLLABUS

EC527 SPEECH PROCESSING & RECOGNITION

Module I:

Speech Production: Introduction, Speech Production Process, Representing Speech in Time and Frequency domains, Speech Sounds and Features, Statistical pattern recognition approach to speech recognition. (8 L)

Module 2:

Signal Processing and Analysis Method for Speech Recognition: Introduction, Linear predictive coding model for Speech Recognition, LPC model, LPC analysis equations, Autocorrelation method, Covariance method, LPC processor for speech recognition, MFCC, Vector quantization: Elements of VQ, VQ training set, Similarity or Distance Measure, Clustering, Vector classification procedure.
(8 L)

Module 3:

Pattern comparison techniques: Introduction, Speech Detection, Distortion Measures, Spectral-Distortion Measures :Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Liftering, Likelihood Distortion, Variance of Likelihood distortion, Time Alignment and Normalization. (8 L)

Hidden Markov Models : Introduction, Discrete-Time Markov Process, Extensions to HMM, Three Basic Problems for HMM, Types of HMM, Implementation issues for HMMs, HMM System for Isolated Word Recognition, Gaussian Mixture Model, HMM-GMM for isolated word recognition.
(8 L)

Module 5:

Applications of Automatic Speech Recognition and Support Vector Machine: Introduction, Support Vector Machines: Linear and Non-linear classifications, Computing the SVM classifier, Properties, Speech-Recognizer Performance Scores, Characteristic of Speech- Recognition Applications, Broad classes of Speech-Recognition Applications, Command and Control Applications, Projections for Speech Recognition, Applications of Speech Recognition in Mobile Phones. .
(8 L)

Text Book:

1. L.R. Rabiner, B.H. Juang and B. Yegnanarayana, “Fundamentals of Speech Recognition”, Pearson, Education 2011.
2. Cristianini Nello and Shawe-Taylor, “An introduction to Support Vector Machines and other kernel based learning methods”, Cambridge University Press, 2000.

Reference Book

1. L.R. Rabiner and R.W. Schafer, “Digital Processing of Speech Signals”, Pearson Education, 2006.

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

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

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC528
Course title: CMOS Digital VLSI Design
Pre-requisite(s): EC101 Basics of Electronics & Communication Engineering
Co- requisite(s):
Credits: L: 3 T: 0 P: 0 C: **3**
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	To apprehend Design technique of Inverter and Combinational Logic Circuits in CMOS and model them with VHDL/Verilog/SystemVerilog.
2.	To perceive Design technique of Sequential Logic Circuits in CMOS and model them using VHDL/Verilog/ SystemVerilog.
3.	To understand Timing Issues in Digital Circuits and model Clock Generator and Test Bench using VHDL/Verilog/SystemVerilog Modelling.
4.	To grasp CMOS Fabrication Process and Manufacturing Issues.
5.	To comprehend data path, memory and control structure design techniques.

Course Outcomes:

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

CO1	Interpret Inverter and Combinational Logic Circuits in CMOS with given design specification such as propagation delay, power dissipation, PDP and EDP.
CO2	Construct and simulate Sequential Logic Circuits in CMOS with given design specification.
CO3	Explain Digital Circuits using VHDL/Verilog/SystemVerilog and model Clock Generator and Test Bench.
CO4	Appraise CMOS Fabrication Process and Manufacturing Issues.
CO5	Design and simulate Datapath, Memory and Control circuits using VHDL/ Verilog/ System Verilog.

SYLLABUS

EC 528 CMOS DIGITAL VLSI DESIGN

Module I:
Design of Inverter and Combinational Logic Circuits in CMOS and their VHDL/Verilog/ System Verilog Modelling:
Static and Dynamic Behaviour of CMOS Inverter: Switching Threshold, Noise Margin formulation, computing capacitance, Propagation Delay, Power, Delay, Power-Delay Product, Energy-Delay Product. Design of CMOS Combinational Logic Circuits: Static CMOS Design: Complementary CMOS, Ratioed Logic, Pass-Transistor Logic; Dynamic CMOS Design: Basic Principles of Dynamic Logic, Speed and Power Dissipation of Dynamic Logic, Signal Integrity Issues in Dynamic Design Cascading Dynamic Gates. Introduction to the SPICE/VHDL/Verilog/SystemVerilog with Design examples of inverter, NAND and NOR gates. (8 L)

Module 2:
Design of Sequential Logic Circuits in CMOS and their VHDL/Verilog/ SystemVerilog Modelling:
Timing Metrics for sequential Circuits, Static Latches and Registers: Bistability Principle, Multiplexer-Based Latches, Master-Slave Edge-Triggered Register, Low-Voltage Static Latches; Dynamic Latches and Registers: Dynamic Transmission-Gate Edge-triggered Registers, C2MOST – A Clock-Skewed Insensitive Approach, True Single-Phase Clocked Register (TSPCR), Alternative Register Styles: Pulse Registers, Sense-Amplifier Based Registers, Pipelining: Latch- versus Register-Based Pipelines, NORA-CMOS—A Logic Style for Pipelined Structures, Nonbistable Sequential Circuits: The Schmitt Trigger, Monostable Sequential Circuits, Astable Circuits, Clocking Strategy; Design examples of latch, flip-flop, register and Memory (RAM, ROM) using SPICE/VHDL/Verilog/SystemVerilog HDL. (8 L)

Module 3:
Timing Issues in Digital Circuits and VHDL/Verilog/SystemVerilog Modelling of Clock Generator and Test Bench:
Timing Classification of Digital Systems: Synchronous Interconnect – Mesochronous interconnect, Plesiochronous Interconnect, Asynchronous Interconnect; Synchronous Design — An In-depth Perspective - Synchronous Timing Basics, Sources of Skew and Jitter, Clock-Distribution Techniques, Latch-Based Clocking; Self-Timed Circuit Design: – Self-Timed Logic - An Asynchronous Technique, Completion-Signal Generation, Self-Timed Signalling, Practical Examples of Self-Timed Logic; Synchronizers and Arbiters: Synchronizers—Concept and Implementation, Arbiters; Clock Synthesis and Synchronization Using a Phase-Locked Loop: Basic Concepts. Building Blocks of a PLL; Future Directions and Perspectives: Distributed Clocking Using DLLs, Optical Clock Distribution, Synchronous versus Asynchronous Design, Design examples of clock and test bench using SPICE/VHDL/Verilog/SystemVerilog HDL. (8 L)

Module 4:
CMOS Fabrication Process and Manufacturing Issues:
CMOS Technologies, Layout Design Rules, CMOS Process Enhancements, Design Rule Checking (DRC), Inverter cross-section, Layout of CMOS Inverter, Layout of 2-input NAND gate, Layout of 2-input NOR gate, Layout of Complex logic gate, Layout of Domino AND gate, Stick Diagrams, Design Partitioning, Floor Planning; **Estimation of parasitics**: diffusion capacitance and interconnect parasitics, package parasitics, impact of parasitics on

circuit performance. **Manufacturing Issues:** Antenna Rules, Layer Density Rules, Resolution Enhancement Rules, Metal Slotting Rules, Interconnect Wearout: Electromigration, Self-heating, Yield Enhancement Guidelines. (8 L)

Module 5:

Design of Datapath, Memory and Control in CMOS and their VHDL/Verilog/SystemVerilog Modelling:

Data operators: single-bit addition, carry-propagate addition, subtraction, multi-input addition, One/Zero detectors, magnitude comparators, equality comparators, counters, Boolean logic operators, Funnel shifters, Barrel Shifter, Array multiplier, Wallace tree multiplier; **Shifter:** Barrel Shifter, Logarithmic Shifter, **Power and Speed Trade-off's in Datapath Structures:** Design Time Power-Reduction Techniques, Run-Time Power Management, Reducing the Power in Standby (or Sleep) Mode; **Memory:** SRAM, DRAM, ROM, Flash memory, FIFO; **Control Structure Design**: Mealy and Moore FSM, state-transition diagram, state reduction technique, control logic implementation, Design examples of Datapath (adder, subtractor, multiplier, comparator, counter, decoder, multiplexer) and control unit (Mealy and Moore FSM) using SPICE/VHDL/Verilog/ SystemVerilog HDL.
(8 L)

Text Book:

2. J. M. Rabaey, A. Chandrakasan, B. Nikolic, "Digital Integrated Circuits – A Design Perspective," 2nd ed., Upper Saddle River, New Jersey, USA: PHI, 2003.
3. N. H. E. Weste and D. M. Harris, "CMOS VLSI Design – A Circuits and Systems Perspective," 4th ed., Boylston Street, Boston, USA: PHI, 2011.
4. S. Palnitkar, "Verilog HDL: A guide to Digital Design and Synthesis," 1st ed., SunSoft Press, 1996.

Reference Book

1. D. L. Perry, "VHDL Programming," 4th ed., Tata McGraw Hill, 2012.
2. Stuart Sutherland, Simon Davidmann, Peter Flake, SystemVerilog Design - A Guide to Using SystemVerilog for Hardware Design and Modeling, 2/e, Springer, 2006

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

Gaps in the syllabus (to meet Industry/Profession requirements): Hands-on-practical for CMOS Digital IC (Integrated Circuit) fabrication.

POs met through Gaps in the Syllabus: PO6 will be met though CMOS Digital circuit design-based assignment in a group, which involves handling of appropriate equipments and/ or CAD tools.

Topics beyond syllabus/Advanced topics/Design: CMOS circuit design related to ADC and DAC.

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC519
Course title: Advanced Instrumentation Lab
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objective:

This course enables the students:

1.	To understand the basics of Instrumentation.
2.	To develop basic and advanced techniques in Instrumentation.
3.	To implement various basic Instrumentation and Virtual Instrumentation Devices.
4.	To develop Ladder diagram for different applications
5.	To understand to Develop Logic-gate and Drink dispenser using PLC

Course Outcome:

After the completion of this course, students will be able to:

CO1	Develop virtual instruments using LabVIEW
CO2	Use Data acquisition system with LabVIEW
CO3	Implement PLC for different applications
CO4	Use of automation studio for interfacing PLC
CO5	To perform Logic-gate and Drink dispenser simulation using PLC

LIST OF EXPERIMENTS

EC 519 ADVANCED INSTRUMENTATION LAB

1. Logic gates implementation using case structure in LabVIEW.

2. Implementation of mathematical operations using Maths block in LabVIEW.

3. Design of function generator and CRO using case structure and for-loop in LabVIEW.

4. To blink LED externally using myRIO DAC card and LabVIEW.

5. To interface a seven-segment LED with myRIO in LabVIEW.

6. To implement a servo feedback control system using myRIO in LabVIEW.

7. To implement an IR range finder in the range of 0cm and 80cm using my RIO in LabVIEW.

8. To implement a sonic range finder with maximum range of 6m using my RIO in LabVIEW.

9. Use of automation studio for interfacing PLC

10. Study of Application of automation studio

11. Logic-gate simulation using PLC.

12. Drink dispenser simulation using PLC

Text Books:

1. Computer Based Industrial Control – By Krishna Kant, PHI
2. Process Control Instrumentation – By Curtis D. Johnson, Pearson Education
3. National Instruments LabVIEW manual.

Reference Books:

1. "Principle of Industrial Instrumentation" By D. Patranabis, TMH publications
2. High performance Instrumentation and Automation, CRC Press, Taylor & Francis Group, 2005

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

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

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC521
Course title: Advanced Sensing Techniques Lab
Pre-requisite(s): Measurement Lab
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objective: This course enables the students:

1.	To understand the principle of operations of different sensors .
2.	To use of Test bench for calibration.
3.	To design fiber optic sensor
4.	To understand to measure speed using tacho-generator
5.	Understand sensitivity and crosss-ensitivity

Course Objective: After the completion of this course, students will be able to:

CO1	Physical parameters measurement and control using respective sensorr
CO2	Use testbench for calibration
CO3	Design fiber optic sensor
CO4	Know the measurement for speed using tacho-generator
CO5	Calculate sensitivity and cross-sensitivity

LIST OF EXPERIMENTS

EC 521 ADVANCED SENSING TECHNIQUES LAB

1. Measurement of vibration

2. Measurement of torque

3. Measurement of conductivity of the liquid.

4. Design of wireless sensor network for room temp measurement.

5. Design of wireless sensor network for pressure ar different points in a process

6. Use of Test bench for calibration of temperature

7. Use of Test bench for calibration of Pressure

8. Use of Test bench for calibration of level

9. Measurement of speed using tacho-generator

10. Design of pressure sensor using fiber optic sensor.

11. Design temperature sensor using fiber optic sensor

12. Find sensitivity and cross sensitivity for pressure sensor at different temperature

Text Books:

1. Sensors and Transducers, by D. Patranabis. 2nd Edition
2. Elctrical & Electronics Measurements and Instrumentation by A.K Sawhney, Dhanpat Rai & Sons.
3. Transducers and Instrumentation, by Murthy D. V. S., Prentice Hall, 2nd Edition, 2011.

Reference Books:

1. Sensor and signal conditioning by John G. Webster, Wiley Inter Science,2nd edition, 2008

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

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

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY 999METHOD

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

COURSE INFORMATION SHEET

Course code: EC523
Course title: Advanced Digital Signal Processing Lab
Pre-requisite(s): Basic courses on Signal and System, DSP
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:

This course enables the students to:

1.	To understand the basics of signals and systems and its characteristics.
2.	To develop basic and advanced techniques in signal processing.
3.	To implement various basic DSP and Advanced DSP techniques in Hardware Platform (DSP Processor kit).
4.	Develop an understanding in analysing a signal and system behaviour in transform domain.
5.	To develop to apply advanced DSP techniques to various engineering applications.

Course Outcomes:

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

CO1	Demonstrate the theoretical knowledge acquired in Digital Signal Processing.
CO2	To illustrate various techniques for signal modeling, representation, synthesis and analysis.
CO3	Demonstrate applications of DSP to analyse signal in transformed domain.
CO4	To apply various DSP algorithms in real life applications with hardware platform.
CO5	Aspire for pursuing a carrier in signal processing, robotics and IOT, recognize the need to learn and adapt to the change in technology and play role of team leader or supporter of team.

LIST OF EXPERIMENTS

EC 523 ADVANCED DIGITAL SIGNAL PROCESSING LAB

1. Computation of the linear convolution and circular convolution of two finite-length sequences.
2. Obtain the Partial Fraction Expansion of the Z-Transform expression and to find its Inverse Z-Transforms. Test the stability of a Discrete Time System.
3. To write a program for finding the DFT and FFT of a Discrete time finite length sequence and implement it in TMS 320C6416 DSK Processor
4. Implement the Linear Convolution using TMS 320C6416 DSK Processor.
5. Development of the program for finding out DFT and FFT of a finite length sequence using TMS 320C6416 DSK Processor.
6. To write a program for designing a Digital Filter using TMS320C641 DSK Processor.
7. Implement LMS and RLS algorithm and perform the convergence analysis.
8. Representation of stationary and non-stationary signals using wavelet transformation.
9. Implementation of sub-band filtering approach using MATLAB.
10. Implement the system identification task in TMS 320C6713 DSK Processor.
11. Write a program for channel equalization and implement in TMS 320C6416 DSK Processor.
12. Write a program to implement the Image enhancement in Image.
13. Analyse the recording of an ECG Signals to measuring Heart Rate Variability.
14. Write an algorithm to perform the Noise cancellation using Adaptive filtering.

Course Evaluation:

Individual assignment, Theory (Quiz and End semester) examinations

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

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

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

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping between Course Outcomes and Program Outcomes

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

< 34% = 1, 34-66% = 2, > 66% = 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

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

COURSE INFORMATION SHEET

Course code: EC549
Course title: Modern Instrumentation System
Pre-requisite(s): Electronic Measurements
Co- requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 03
Class: M. Tech.
Semester / Level: I/05
Branch: ECE
Name of Teacher:

Course Objectives:

This course enables the students:

1.	The knowledge about Silicon Sensors and its application for measurement of pressure, level, flow and Temperature. Biosensors
2.	The knowledge about DAS, Controller and Components involved in implementation of Automation system
3.	The knowledge about Distributed Control Systems
4.	The knowledge about Artificial Intelligent Based Systems
5.	The knowledge about microcontroller and Telemetry

Course Outcomes:

After the completion of this course, students will be:

CO1	Gain knowledge of Silicon Sensors and its application for measurement of pressure, level, flow and Temperature. Biosensors
CO2	Gain knowledge of DAS, Controller and Components involved in implementation of Automation system
CO3	Gain knowledge of Distributed Control Systems
CO4	Gain knowledge of Artificial Intelligent Based Systems
CO5	Gain knowledge of about microcontroller and Telemetry

SYLLABUS

EC 549 MODERN INSTRUMENTATION SYSTEM

Module I:
Review of Transducer, Principles of operations and its classification, Characteristics, Technological trends in making transducers, Silicon sensors for the measurement of pressure, level, flow and Temperature. Biosensors, application and types. (8 L)

Module 2:
Introduction about Instrumentation system. Types of Instrumentation system. Data acquisition system and its uses in intelligent Instrumentation system. Detail study of each block involved in making of DAS, Signal conditioners as DA, IA, signal converters (ADC), Sample and hold. Designing application for Pressure, Temperature measurement system using DAS. Data logger. (8 L)

Module 3:
Introduction about Automation system. Concepts of Control Schemes, Types of Controllers. Components involved in implementation of Automation system i.e., DAS, DOS, Converter (I to P) and Actuators: Pneumatic cylinder, Relay, solenoid (Final Control Element), Computer Supervisory Control System (SCADA), Direct Digital Control's Structure and Software. (8 L)

Module 4:
Introduction about Distribution Digital Control, Functional requirements of process control system, system architecture, Distributed Control systems, Configuration, Some popular Distributed Control Systems. Industrial control applications like cement plant, thermal power plant.
Introduction about Intelligent controllers, Model based controllers, Predictive control, Artificial Intelligent Based Systems, Experts Controller, Fuzzy Logic System and Controller, Artificial Neural Networks, Neuro-Fuzzy Control system. (8 L)

Module 5:
Introduction to microcontroller 8051, its architecture, register, pin descriptions, addressing modes, instruction set and simple programs. Industrial application of micro controller-measurement applications, automation and control applications
Introduction to telemetry, telemetry links, signal characterisations in time and frequency domain, analog and digital signals. Data transmission systm,Advantages and disadvantages of digital transmission over analog one. Time division multiplexing ,pulse modulation, Digital modulation ,Pulse code modulation and Modem. (8 L)

Text Book:
1. Computer Based Industrial Control – By Krishna Kant, PHI
2. Process Control Instrumentation – By Curtis D. Johnson, Pearson Education

Reference Book:
1. Electrical & Electronics Measurements and Instrumentation By A.K.Shawhney, Dhanpat Rai & Sons.
2. Electronics instrumentation By H. S. Kalsi [TMH]

Course Evaluation:
Individual assignment, Theory (Quiz and End semester) examinations

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

Topics beyond syllabus/Advanced topics/Design:

Course Delivery Methods

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
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MAPPING BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

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

< 34% = 1, 34-66% = 2, > 66% = 3

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