M. TECH. **CURRICULAM & SYLLABUS**

M.Tech - CONTROL & INSTRUMENTATION ENGINEERING

(Regulation 2014)

KALASALINGAM UNIVERSITY

(Kalasalingam Academy of Research and Education)

(Under Section of UGC Act 1956)

Anand Nagar, Krishnan Koil – 626 126.

Srivilliputtur (via), Virudhunagar Dt., Tamil Nadu, INDIA.

VISION AND MISION OF THE UNIVERSITY

VISION

To be a Center of Excellence of International Repute in Education and Research.

MISSION

To Produce Technically Competent, Socially Committed Technocrats and Administrators through Quality Education and Research.

VISION OF THE DEPARTMENT

VISION

To emerge as a diversified knowledge sharing and research driven base in the domain of Instrumentation and Control Engineering.

MISSION

- To provide quality education in the domain of Instrumentation and Control Engineering through updated curriculum, effective Teaching and Learning process and state of the art Laboratory facilities.
- To provide opportunities for students and researchers to carryout research on advanced topics of Instrumentation and control system.
- To produce technically competent and readily employable Instrumentation and Control graduates with ample exposure towards team work, ethical standards and social responsibilities.

PROGRAMME EDUCATIONAL OBJECTIVES

The graduates of the department of Instrumentation and Control Engineering will be capable of:

PEO 1- Graduates of the programme will have professional competency by successful career in Instrumentation, control and inter- disciplinary fields

PEO 2- Graduates of the programme will demonstrate life-long independent skills in research and contribute to technological growth in control and instrumentation

PEO 3- Graduates of the programme will exhibit project management skills and ability to work in team to perform collaborative, multidisciplinary tasks in their profession.

PROGRAMME OUTCOMES

The Outcomes of Under Graduate Programme in the Department of Instrumentation and Control Engineering are as follows:

On completion of the Post Graduate Programme, the students would possess the ability to:

1. Apply the knowledge gained through Science, Mathematics, fundamentals of Engineering and preliminary ideals of Instrumentation and Control Engineering to invoke a basic framework of Engineering models.

2. Identify, formulate and solve complicated problems arising in the domains of Linear and non linear systems, Sensors & Transducers, process control, Biomedical Instrumentation and Digital signal Processing, to derive a conclusion using the principles of Mathematics and fundamental Engineering.
3. Indulge in the process of designing/development of Digital control systems, Microprocessor and Microcontroller oriented systems and Industrial Automation through software, so as to meet the large scale professional requirements and expectations of industries.
4. Design and perform experiments in relation to Process Control, Robotics, Intelligent Instrumentation, intensified data analysis and conversions to derive out conclusive statements through the processes of simulation, numerical calculations and graphical representations.
5. Create, Select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex control engineering with an understanding of the process complexity.
6. Assess social, legal and culture associated issues, with a clear knowledge about the roles and responsibilities of an engineer through a professional approach in collaborative and interdisciplinary research.
7. Gain knowledge about the ongoing contemporary issues in the field of control and Instrumentation and apply it in one’s work as a member and leader in a team.
8. Understand social responsibilities and professional ethics, and follow them regularly and Communicate with the engineering community, and with society at large, regarding complex engineering issues.
9. Able to engage in life-long learning independently, with a high level of confident and commitment to improve knowledge in control and instrumentation.
10. Appreciable communication schemes and drafting out significant reports and recording the processes/operations through effective documentation, with subsequent best impressions to the clients/customers/organization through presentations.
11. Handle and improvise projects related to engineering and management principles through the knowledge gained during the period of study.
12. Compatibility and long term self learning ability to meet the needs of Instrumentation and Control related Engineering.

Semester I

Code	Subject	L	T	P	C
MAT5001	Applied Mathematics	3	0	0	3
ICE5001	Linear and Non-linear Systems Theory	3	0	0	3
ICE5002	Digital Signal Processing	3	0	0	3
ICE5003	Sensors and Transducers	3	0	0	3
ICE5004	Process Control and Instrumentation	3	0	0	3
ICE5081	Advanced Process Control Laboratory	0	0	3	2
ICEXXXX	Elective I	3	0	0	3
	TOTAL	18	0	3	20

Semester II

Code	Subject	L	T	P	C
ICE5005	System Identification and Adaptive Control	3	0	0	3
ICE5006	Digital Control System	3	0	0	3
ICE5007	PC Based Instrumentation	3	0	0	3
ICE5008	Control System Design	3	0	0	3
ICE5009	Intelligent Control	3	0	0	3
ICE5082	Modeling And Simulation Lab	0	0	3	2
ICEXXXX	Elective II	3	0	0	3
	Total	18	0	3	20

Semester III

Code	Subject	L	T	P	C
ICEXXXX	Elective III	3	0	0	3
ICEXXXX	Elective IV	3	0	0	3
ICEXXXX	Elective V	3	0	0	3

ICE6098	Project Work (Phase I)	0	0	18	6
	Total	9	0	18	15

Semester V

Code	Subject	L	T	P	C
ICE6099	Project Work (Phase II)	0	0	36	12

Total Credit-67
Electives

Code	Subject	L	T	P	C
ICE5010	Robotics and Automation	3	0	0	3
ICE5011	Advanced Topics in Instrumentation Systems	3	0	0	3
ICE5012	Bio-Medical Instrumentation	3	0	0	3
ICE5013	Computer Aided Analysis And Design of Systems	3	0	0	3
ICE5014	Digital Signal Processors	3	0	0	3
ICE5015	Optimal & Adaptive Control	3	0	0	3
ICE6001	Advanced Power Semiconductor Devices	3	0	0	3
ICE6002	Neural Network & Fuzzy logic Control	3	0	0	3
ICE6003	Digital Image Processing	3	0	0	3
ICE6004	Process Dynamics and Control	3	0	0	3
ICE6005	Reliability & Safety Engineering	3	0	0	3
ICE6006	Micro-Controller Based System Design	3	0	0	3
ICE6007	Advanced Sensor Technology	3	0	0	3
ICE6008	Virtual Instrumentation	3	0	0	3
ICE6009	Real-Time Instrumentation Techniques	3	0	0	3
ICE6010	Multi-Variable Control System	3	0	0	3
ICE6011	Fault Diagnosis and Control	3	0	0	3

SEMESTER -I

MAT5001	APPLIED MATHEMATICS	L	T	P	C
		3	0	0	3

PREREQUISITE

Basic concepts of matrix theory, differentiation, integration, Random process and differential equations.

COURSE OBJECTIVES

- To familiarize the students with the concept and techniques of differentiation and integration and their applications to engineering problems**.**
- To study the Eigen value problems and Differential equations.
- To grasp the concepts in three dimensional geometry.

COURSE OUTCOMES

CO1: Find the Eigen values of a matrix and to use Cayley-Hamilton theorem & Jordan canonical form for finding the inverse of a matrix.
CO2: find the calculus of variation using different methods.
CO3: Apply partial derivatives to linear problems.
CO4: Apply optimality concept for various dynamics problems
CO5: Apply the random theory for performing random theory.

ADVANCED MATRIX THEORY

Matrix norms – jordan canonical form – generalized eigen vectors – singular value decomposition – pseudo inverse – least square approximations – QR algorithm

CALCULUS OF VARIATIONS

Variation **-** its properties euler's equation – functional dependent on first **-** higher order derivates – functional dependent on functions of several independent variables – some applications – direct methods **-** ritz **-** kanorovich methods

LINEAR PROGRAMMING

Basic concepts – graphical **-** simplex methods – transportation problem – assignment problem

DYNAMIC PROGRAMMING

Elements of the dynamic programming model – optimality principle – examples of dynamic programming models and their solutions

RANDOM PROCESS

Classification – stationery random processes – auto correlation – cross correlations – power spectral density – linear system with input – gaussian process

TEXT BOOKS

1. Taha, H. A., Operations Research – An Introduction, 6th edition, Prentice-Hall of India, New Delhi, 1999
2. Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw–Hill, New York, 1989
3. Peeles Jr., Probability, Random Variables and Random Signal Principles, McGraw-Hill Inc., 1993

REFERENCES

1. Lewis, D. W., Matrix Theory, Allied Publishers, Chennai ,1995
2. Gupta, A. S., Calculus of Variations with Applications, Prentice-Hall of India, New Delhi, 1999

3. Gupta, P. K., Hira, D.S., Operations Research, S. Chand & Co. New Delhi, 1999
4. Ochi, M. K., Applied Probability and Stochastic Processes, John Wiley & Sons, 1992

ICE5001	LINEAR AND NON-LINEAR SYSTEMS THEORY	L	T	P	C
		3	0	0	3

PRE-REQUISTIE:
MAT201,EIE208,EIE306

COURSE OUTCOME:
After the successful completion of the course, the students will be able to:
CO1: Understand the state and state variable of the system
CO2: Analyze the linear system using state space analysis.
CO3: Understand the concept of non-linearity in the process system.
CO4: Analyze the stability of the physical system.
CO5: Synthesis & analyze the controller for nonlinear system

PHYSICAL SYSTEMS AND STATE ASSIGNMENT
Systems - Electrical - Mechanical – Hydraulic – Pneumatic – Thermal systems – Modelling of some typical systems like DC Machines - Inverted Pendulum
STATE SPACE ANALYSIS
Realization of state models: minimal realization – balanced realization – solution of state equations: – state transition matrix - its properties - free - forced responses – properties - controllability – observability - stabilisability – detectability.
NON-LINEAR SYSTEMS
Types of non-linearity – Typical examples – Equivalent linearization - Phase plane analysis – Limit cycles – Describing functions- Analysis using Describing functions- Jump resonance
STABILITY
Stability concepts – equilibrium points – BIBO and asymptotic stability – direct method of liapunov – application to non-linear problems – frequency domain stability criteria – popov's method and its extensions
CONTROLLER SYNTHESIS FOR NON-LINEAR SYSTEMS

Linear design and non-linear verification – Non-linear internal model control – Parameter optimization – Model predictive controller – Optimal controller – State feedback and observer.

TEXT BOOKS
1. Gopal. M., Modern Control Engineering, Wiley, 1996.
2. Bay.J.S., Linear State Space Systems, McGraw-Hill, 1999.
3. M. Chidambaram, " Computer Control of Process", Alpha Science International, Ltd., 2002.
4. Chi-Tsong Chen, "Linear System Theory and Design", 3rd edition, Oxford University Press, 1999.
REFERENCES
1. Eroni-Umez and Eroni, "System dynamics & Control", Thomson Brooks Cole, 1998.
2. K. Ogatta, "Modern Control Engineering", Pearson Education Asia, Low Priced Edition, 1997.
3. Glad.T.,Ljung.L., Control Theory – Multivariable and Non-linear methods, Taylor and Francis, London and NY.
5. G. J. Thaler, "Automatic Control Systems", Jaico publishers, 1993.

ICE5002	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

PRE-REQUISITE:
MAT201, EIE206, MAT211

COURSE OBJECTIVES :
To familiarise the students with

- The basic concepts and techniques for processing signals on a computer.
- Signals, systems, time and frequency domain concepts which are associated with the mathematical tools. ie fundamental to all DSP techniques.
- To provide a thorough understanding and working knowledge of design, implementation, analysis and comparison of digital filters for processing of discrete time signals.
- To study various sampling techniques and different types of filters and will also understand basic principles of estimation theory.
- The most important methods in DSP, including digital filter design, transform-domain processing and importance of signal processors.

COURSE OUTCOME:
Students will be able to,
CO1:Analyse and process signals in discrete domain.
CO2: Design IIR filters to suit specific requirements for specific applications.
CO3: Design FIR filters to suit specific requirements for specific applications.
CO4: Compute statistical analysis and inference on random signals.
CO5: Design multirate signal processing algorithms to suite specific needs.

DISCRETE TIME SIGNALS AND SYSTEMS
Representation of discrete time signal – classifications – Discrete time – system – Basic operations on sequence – linear – Time invariant – causal – stable – solution to difference equation – convolution sum – correlation – Discrete time Fourier series – Discrete time Fourier transform

FOURIER AND STRUCTURE REALIZATION
Discrete Fourier transform – properties – Fast Fourier transform – Z-transform – structure realization – Direct form – lattice structure for FIR filter – Lattice structure for IIR Filter

FILTERS
FIR Filter – windowing technique – optimum equiripple linear phase FIR filter – IIR filter – Bilinear transformation technique – impulse invariance method – Butterworth filter – chebyshev filter

MULTISTAGE REPRESENTATION
Sampling of band pass signal – anti aliasing filter – decimation by a n integer factor – interpolation by an integer factor – sampling rate conversion – implementation of digital filter banks – sub-band coding – quadrature mirror filter – A/D conversion – quantization – coding – D/A conversion

DIGITAL SIGNAL PROCESSORS
Fundamentals of fixed point DSP architecture – fixed point number representation and computation – fundamentals of floating point DSP architecture – floating point number representation and computation – study of TMS 320 C 50 processor – Basic programming – addition – subtraction – multiplication – convolution – correlation – study of TMS 320 C 54 processor – basic programming – addition – subtraction – multiplication – convolution – correlation

TEXT BOOKS

1. John G. Proakis., Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, India, 4th edition, 2004

REFERENCES

1. Salivahanan.S., et al, Digital Signal Processing, Tata Mcgraw Hill, 2000
2. Oppenheim.V., et al, Digital Signal Processing, Prentice-Hall, Inc, 1975
3. Venkatramani, Bhaskar.M., Digital Signal Processors architecture, programming and applications, Tata Mcgraw Hill, 2002

ICE5003	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

PRE-REQUISITE:

a. Fundamentals of Basic Engineering
b. Basic Knowledge in measurements
c. Basic Idea about sensors
d.

COURSE OBJECTIVES:

To learn about

a. Measurement Systems
b. Working and applications of Various Transducers

COURSE OUTCOMES:
After the successful completion of the course, the students will be able to:
CO1: Understand various types of Sensors & Transducers and their working principle
CO2: Analyze the smart sensors for their relevant applications.
CO3: Develop the knowledge of some of the semiconductor& IC sensor.
CO4: Understand the characteristics of various transducers
CO5: Apply the knowledge of signal condition to various transducers.

INTRODUCTION TO SENSORS

Introduction- Classification of sensors- Capacitance sensors – Eddy current sensors – Piezoelectric sensors - Photo-electric sensors- Hall effect sensors – Electro dynamic sensors – Nuclear radiation sensors – Ultra sonic sensors – Smart sensors – Fibre optic sensors – Semiconductor IC sensors.

SMART SENSORS AND RECENT TRENDS IN SENSOR TECHNOLOGIES
Primary sensors, filters, converter – compensation – Non-linearity- Noise and interference – Drift – Data Communication – Standards for smart sensor interface –Semiconductor IC technology – MEMS – Nano sensors

SEMICONDUCTOR AND IC SENSORS

Requirements on Sensor Diodes – Applications of sensor diodes - Characteristics - Manufacturing techniques – Silicon temperature sensors – AD 7414 – Photo Diodes - Optical sensors – Opto semiconductors – Industrial Auto sensors - AD 22050 – Characteristics

INTRODUCTION TO TRANSDUCERS

Classification of transducers – Potentiometers – Differential transformers – Resistance strain gauges – Resistance temperature detectors – Thermistors – Thermocouples –applications

SIGNAL CONDITIONING CIRCUITS

Wheat stone bridge circuits – Operational amplifiers – Instrumentation amplifiers – Active filters – Modulation and demodulation circuits – F/V and V/F converters –D/A and A/D converters – Multiplexers and S/H circuits.

TEXT BOOKS

1. Patranabis, D., "Sensors and Transducers", Wheeler Publishing, 1997.
2. C.S.Rangan, G.R.Sarma, V.S.V.Mani, "Instrumentation Devices and systems", Tata McGraw-Hill Publishing Co. Ltd., Second Edition, 1999

REFERENCE BOOKS

3. Jones, B.E., "Instrument Technology", Vol.3 Butter worth and Co., Publishers, 1987.
4. Neubert, "Instrument Transducers", Oxford University press, 1998.
5. Ernest O. Doebelin, "Measurement Systems", McGraw-Hill Publishing Co., 1990.
6. Andrew Parr," Industrial Control – Handbook," Newnes Industrial press –New Delhi 1998
7. James Dally, W., "Instrumentation for Engineering Measurements", John Wiley & sons, Inc., 1993.
8. Sze Simon," Semiconductor sensors " Alibris Publications

ICE5004	PROCESS CONTROL AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

PRE-REQUISITE:

Knowledge of system transfer function, control action, controllers and final control element is required.

COURSE OBJECTIVES:

- To study the basic characteristics of first order and higher order processes.
- To get adequate knowledge about the characteristics of various controller modes and methods of controller tuning.
- To study about various complex control schemes.
- To study about the construction, characteristics and application of control valves.

COURSE OUTCOME:

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

CO1 – Understand the mathematical modeling, controllers, final control elements and tuning processes.

CO2: Apply fundamental knowledge of mathematics to modeling and analysis of fluid flow, level, pressure, temperature problems.

CO3: Conduct experiments in pipe flows and open-channel flows and interpreting data from model studies to prototype cases. Documenting them in engineering reports.

CO4: Understand the possible disasters caused by an incorrect Design/Analysis in hydraulic, pneumatic engineering system.

PROCESS DYNAMICS
Introduction to process control - objective of modeling - models of industrial process - hydraulic tanks - fluid flow systems - mixing process - chemical reactions - thermal systems-heat exchangers - distillation column

CONTROL ACTIONS AND CONTROLLER TUNING
Basic control actions-on/off – P - P+I - P+I+D - floating control - pneumatic - electronic controllers - controller tuning-time response - frequency response methods - non-linear controllers

COMPLEX CONTROL TECHNIQUES
Feed forward-ratio – cascade - split range – inferential – predictive - adaptive - multivariable control

PROGRAMMABLE LOGIC CONTROLLERS
Evolution of PLC – Sequential - Programmable controllers – Architecture – Programming of PLC – Relay logic - Ladder logic – Functional blocks – Communication Networks for PLC

DISTRIBUTED CONTROL SYSTEM
Evolution of DCS – Architecture – Local control unit – Operator interface – Engineering interface – Display – Case studies in DCS

TEXT BOOKS
1. Dale E. Seborg, et al, Process dynamics and control, Wiley John and Sons, 1989
2. Norman A Anderson, Instrumentation for Process Measurement and Control, CRC Press LLC, Florida, 1998

REFERENCES
1. George Stephanopoulos, Chemical Process Control, Prentice Hall India
2. Harriot P., Process Control, Tata Mc Graw-Hill, New Delhi, 1991
3. Marlin T. E., Process Control, Tata McGraw hill, New York, 2nd edition, 2000
4. Balchan J. G., Mumme G., Process Control Structures and Applications, Van Nostrand Renhold Co., New York, 1988

		L	T	P	C
ICE5081	**ADVANCED PROCESS CONTROL LAB**	0	0	3	2

PRE-REQUISITE

The knowledge about basic control system design, Fundamentals of Mathematical equations are required.

COURSE OBJECTIVES:

- **Use and apply modern computational techniques and tools for solving chemical process control problems**
- **Become familiar with industrial Chemical Process Systems**

COURSE OUTCOME:
After the successful completion of the course, the students will be able to:

CO1: Apply the control system to industrial parameters like that- fluid flow, level, pressure, temperature problems.
CO2: Conduct experiments (in teams) in pipe flows and open-channel flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports.
CO3: Understand disasters caused by incorrect design/analysis in hydraulic, pneumatic engineering system.
CO4: Identify optimal values for PID controller for any application.

List of Experiments:

1. Modeling of Temperature process
2. Modeling of flow process
3. Modeling of level process
4. Modeling of pressure process
5. PID Controller tuning for various process (Flow, Temperature, Pressure, Level)
6. Design of software PID controller
7. Design of Fuzzy logic controller
8. PID controller using PLC
9. Cascade Control
10. Ratio Control
11. Modeling and control of pH using distributed control system.
12. Modeling and control of concurrent heat exchanger using Distributed control system.
13. Modeling and control of countercurrent heat exchanger using Distributed control system.
14. Non-linear identification of pH process.

SEMESTER -II

		L	T	P	C
ICE5005	**SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL**	3	0	0	3

OBJECTIVES:
The objective of this course is to expose students to different system identification concepts.

COURSE OUTCOME:

Upon completing the course, the student should have understood
CO1: The concepts required for development of mathematical models for industrial systems.
CO2: Development of models from first principles.
CO3: Development of data driven models

SYSTEMS AND MODELS
Models of LTI systems - Linear Models - State space Models - Model sets - Structures and Identifiability - Models for Time-varying - Non-linear systems - Models with Nonlinearities – Non-linear state - space models - Black box models - Fuzzy models - Model approximation – validation - Random Process Modelling

PARAMETRIC AND NON-PARAMETRIC ESTIMATION METHODS
Transient response - Correlation Analysis – Frequency response analysis – Spectral Analysis – Least Square – Recursive Least Square – Maximum Likelihood – Instrumental Variable methods – Pseudo Linear Regression

LINEAR AND NON-LINEAR ESTIMATION TECHNIQUES
Open - Closed loop identification - Approaches – Direct - indirect identification – Joint input - output identification – Non-linear system identification – Wiener models – Power series expansions - Multidimensional Identification – State estimation techniques – FFT based - Model based Spectral estimation techniques

CLASSIFICATION OF ADAPTIVE CONTROL
Introduction – Uses – Auto tuning – Self Tuning Regulators (STR) – Model Reference Adaptive Control (MRAC) – Types of STR - MRAC – Different approaches to self-tuning regulators – Stochastic Adaptive control – Gain Scheduling

APPLICATIONS OF ADAPTIVE CONTROL
Recent trends in self – tuning – Stability, Convergence and Robustness studies - Model Updating – General purpose Adaptive regulator – Applications to process control

TEXT BOOKS
1. Narendra , Annasamy, Stable Adaptive Control Systems, Prentice Hall, 1989

REFERENCES
1. Ljung, System Identification Theory for the User, PHI, 1987
2. Astrom, Wittenmark, Adaptive Control , PHI

ICE5006	DIGITAL CONTROL SYSTEM	L	T	P	C
		3	0	0	3

PRE-REQUISITE
To provide sound knowledge on the principles of discrete data control system

Course Objectives:
To equip the students with the basic knowledge of A/D and D/A conversion
To understand the basics of Z- Transform
To study the stability analysis of digital control system
To equip the basic knowledge of digital process control design

COURSE OUTCOMES:
Student can be able to:
CO1: Students will have the basic knowledge of A/D and D/A conversion
CO2: Students will have the knowledge of Z- Transform
CO3: Students will have knowledge of digital process control design
CO4: Design and compensate the digital control system.

INTRODUCTION
Sampling and holding – Sample and hold devices – D/A and A/D conversion – Reconstruction – Z transform – Inverse Z transform – Properties – Pulse transfer function - state variable approach – Review of controllability - observability

DESIGN USING TRANSFORM TECHNIQUES
Methods of discretisation – Comparison – Direct design – Frequency response methods

DESIGN USING STATE SPACE TECHNIQUES
State space design – Pole assignment – Optimal control – State estimation in the presence of noise – Effect of delays

COMPUTER BASED CONTROL
Selection of processors – Mechanization of control algorithms – PID control laws predictor merits and demerits – Application to temperature control – Control of electric drives – Data communication for control

QUANTIZATION EFFECTS AND SAMPLE RATE SELECTION
Analysis of round off error – Parameter round off – Limit cycles and dither – Sampling theorem limit – Time response and smoothness – Sensitivity to parameter variations – Measurement noise and anti aliasing filter – Multi-rate sampling

TEXT BOOK
1. Gopal. M., "Digital control Engineering", Wiley Eastern Ltd.1989

REFERENCES
1. G. F. Franklin, J. David Powell, Michael Workman, "Digital control of Dynamic Systems", 3rd Edition, Addison Wesley, 2000
2. Paul Katz, "Digital control using Microprocessors", Prentice Hall, 1981
3. Forsytheand. W. Goodall. R. N., "Digital Control", McMillan,1991
4. Chesmond, Wilson, Lepla, "Advanced Control System Technology", Viva – low price edition, 1998

ICE5007	PC BASED INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:
1. It is to provide and ensure a comprehensive understanding of using personal computers in measurement and control instrumentation.
2. Learn the process of collecting information/ data through PC from real world sources.
3. Learn remote and networked data acquisition and operating system.
4. Learn programmable logic controllers, and its application.

COURSE OUTCOMES:
CO1. Understand the main functional units in a PC and be able to explain how they interact. They should know different bus types, and on this basis be able to distinguish account for different generations of PCs.
CO2. Understand an operating systems and their importance such as multitasking, privilege levels and drivers.
CO3. Solve simple instrumentation tasks using both PC and microcontroller. They shall also master programming in C and LabVIEW on a level that enables them to solve such tasks.
CO4. At the end of each chapter, review question, problems given to reinforce their understanding of the concepts to re-in force their command and over these aspect to implement in projects

INTRODUCTION TO PC BASED INSTRUMENTATION

PC opened up and architecture - General structure of PC based instrumentation – Advantages - disadvantages of computer based instrumentation - Comparison with other control systems - Various instrumentation packages like Lab View, Genie etc

BUSES AND STANDARDS & I/O INTERFACING CARDS
Introduction- BUS types- The I/O BUS- ISA bus - EISA Bus - PCI bus – GPIB - RS-232 - Digital input-output card PCL – 225 - Block diagram description - Opto Input - output card- - Block diagram description

PARALLEL PORT INTERFACING
Parallel Port (PP) Interfacing Techniques - parallel port - parallel port as output port -programming of PP- parallel port as input port and its programming

SERIAL PORT INTERFACING
Serial Port (SP) Interfacing Techniques - serial port - Serial port as output port - Programming of SP - Serial port as input port and its programming

CASE STUDY
CNC Motion controller - Power plant controller - Cement plant control - Sugar plant control - Textile plant control

TEXT BOOKS

1. Douglas V. Hall, Microprocessors and Interfacing, TMH
2. Ahson, S. I, Microprocessors with applications in process control, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1984
3. Krishna Khan, Computer based industrial control, Prentice Hall, 1997

REFERENCES

1. Kevin M. Daugherly., - Analog to digital conversion, a practical conversion , McGraw Hill
2. George Barney C., Intelligent Instrumentation, Prentice Hall of India Pvt. Ltd., New Delhi, 1998

ICE5008	CONTROL SYSTEM DESIGN	L	T	P	C
		3	0	0	3

PRE-REQUISITE

- To provide sound knowledge in the basic concepts of linear control theory and design of control system.
- To provide sound knowledge in the basic concepts of linear control theory and design of control system.

OBJECTIVES

- To understand the methods of representation of systems and to desire their transfer function models.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To understand the concept of stability of control system and methods of stability analysis.
- To study the three ways of designing compensation for a control system.

INTRODUCTION TO DESIGN AND CLASSICAL PID CONTROL

Systems performance - specifications – proportional - integral - derivative controllers – structure – empirical tuning - zeigler nichols - cohen coon – root locus method – open loop inversion - affine parameterisation – tuning using ISE - IAE

CLASSICAL APPROACH AND COMPENSATOR DESIGN
Design of lag, lead - lead-lag compensators – design using bode plots – polar plots – nichols charts – root locus - routh hurwitz criterion

STATE VARIABLE DESIGN
Design by state feedback – output feedback – Pole assignment technique – Design of state feedback - output feedback controllers – Design of reduced and full order observers – PI feedback – Dynamic state feedback

OPTIMAL CONTROLLER DESIGN
Statement of optimal control problem – Solution using variational approach – Ricatti equation – Solution – Infinite time problems – Solution - robust control - H∞ - H2 optimal control

CASE STUDIES
Satellite altitude control – Lateral and Longitudinal control of Boeing 747, Control of Fuel-air ratio in automotive engine – Control of a digital tape transport – Control of Read/Write Head assembly of a Hard disk

TEXT BOOK

1. Gopal. M, Control Systems Principles and Design, Tata Mc Graw Hill, New Delhi, 1998

REFERENCES

1. Goodwin G.C., et al, Control system design, Pearson Education, 2003
2. Franklin. G.F., et al, Feedback Control of Dynamic Systems , Pearson Education systems, 2002

ICE5009	INTELLIGENT CONTROL	L	T	P	C
		3	0	0	3

PRE-REQUISITE:
Students are required to be familiar with Basic concepts in controller design and Matrices.

OBJECTIVES:
To learn the design, tuning, and development of ANN &Fuzzy Logic Controllers (FLC)
To acquire basic understanding of the various algorithms involved in Neural Networks, Genetic & Fuzzy logic
To apply the intelligent controller in process control application.

COURSE OUTCOME:
Upon the completion of this subject, the student will be able to
CO1: Understand the basic intelligent controller concept
CO2: Understand concepts of feed forward neural networks and learning and understanding of feedback neural networks.
CO3: Understand and analyze the concept of genetic algorithm.
CO4: Understand the knowledge of fuzzy logic control.
CO5: Apply the knowledge of fuzzy logic control, genetic algorithm and neural network to the real problems.

INTRODUCTION
Approaches to intelligent control - Architecture for intelligent control - Symbolic reasoning system - rule-based systems - the AI approach - Knowledge representation - Expert systems

ARTIFICIAL NEURAL NETWORKS
Concept of Artificial Neural Networks - its basic mathematical model - McCulloch-Pitts neuron model - simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller

GENETIC ALGORITHM
Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems

FUZZY LOGIC SYSTEM
Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system

APPLICATIONS
GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems

TEXT BOOKS
1. Jacek. M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, 1999
2. Driankov, Hellendroon, Introduction to Fuzzy Control, Narosa Publishers

REFERENCES
1. Kosko, B., Neural Networks And Fuzzy Systems, Prentice-Hall of India Pvt. Ltd., 1994
2. Klir G .J., Folger T. A., Fuzzy sets, uncertainty and Information, Prentice-Hall of India Pvt. Ltd., 1993
3. Zimmerman H. J., Fuzzy set theory-and its Applications, Kluwer Academic Publishers, 1994
4. Goldberg, D.E., Genetic algorithms in search, optimization and machine learning, Addison-Wesley, Reading, MA, 1989

		L	T	P	C
ICE5082	**MODELLING AND SIMULATION LAB**	0	0	3	2

PRE-REQUISITE

The knowledge about basic control system design, Fundamentals of Mathematical equations are required.

COURSE OBJECTIVES:

- Use and apply modern computational techniques and tools for solving chemical process problems
- Become familiar with modeling of Chemical Process Systems.

COURSE OUTCOME:
After the successful completion of the course, the students will be able to:

CO1: Apply the control system to industrial parameters like that- fluid flow, level, pressure, temperature problems.
CO2: Conduct experiments in pipe flows and open-channel flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports.
CO3: Understand disasters caused by incorrect design/analysis in hydraulic, pneumatic engineering system.
CO4: Identify optimal values for fuzzy controller for any application.

List of Experiments:

1. Design a lead compensator for a Temperature control system.
2. Design an estimator for a simple Pendulum and also design a reduced order estimator for the same.
3. Design a full order and reduced order compensator for satellite altitude control.
4. Design an integral control law for a motor speed system.
5. Design a system with pure time delay on heat exchanger model.
6. Design a full order observer for specified pole locations on a satellite model.
7. Design a tracking control to follow a sinusoid for a disk drive servomechanism using matlab and simulink.
8. Design a fuzzy logic controller for liquid level system.
9. Realization of z transforms and its properties for given systems.

ELECTIVES

		L	T	P	C
ICE5010	**ROBOTICS AND AUTOMATION**	3	0	0	3

PRE-REQUISITE:
Knowledge of sensors, drives (Actuators) and basic concept in Programming.

OBJECTIVES:

- To provide comprehensive knowledge of robotics in the design, analysis and control point of view.
- Gaining knowledge to design a robot for Industrial applications.

COURSE OUTCOME:
Student will be able to,
CO1: Know the concept, types and general applications of robotics.
CO 2: Know the various parts of robot.
CO 3: Study the various kinematics and dynamics of robots.
CO 4: Know the various programming methods.
CO5: Study the applications of robots in manufacturing and non-manufacturing sectors.

INTRODUCTION

Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors – End effectors – Control systems – Robot programming languages and applications – Introduction to robotic vision

ROBOT ARM KINEMATICS
Direct and inverse kinematics – Rotation matrices – Composite rotation matrices – Euler angle representation – Homogenous transformation – Denavit Hattenberg representation and various arm configuration

ROBOT ARM DYNAMICS
Lagrange – Euler formulation, joint velocities – Kinetic energy – Potential energy and motion equations – Generalised D'Alembert equations of motion

PLANNING OF MANIPULATOR TRAJECTORIES
General consideration on trajectory planning joint interpolation & Cartesian path trajectories

CONTROL OF ROBOT MANIPULATORS
PID control computed, torque technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Resolved motion control and adaptive control

TEXT BOOKS

1. Wesley, E. Sryda, Industrial Robots: Computer interfacing and Control PHI, 1985
2. Saeed B. Niku, Introduction to Robotics, Analysis, systems and Applications, Pearson Education, 2002

REFERENCES

1. Lee, C. S. G., et al ,Robotics (Control, Sensing, Vision and Intelligence), McGraw-Hill, 1968
2. Asada, Slotine, Robot Analysis and Control, John Wiley and Sons, 1986
3. Groover M. P. Mitchell Wesis., Industrial Robotics Technology Programming and Applications, Tata McGraw-Hill, 1986

ICE5011	ADVANCED TOPICS IN INSTRUMENTATION SYSTEMS	L	T	P	C
		3	0	0	3

PRE – REQUISITE:

Knowledge of sensors measurements system is required.

OBJECTIVES:

- To provide comprehensive knowledge of instrumentation in the design, analysis and control point of view.
- Gaining knowledge to design an Instrument for Industrial applications.

COURSE OUTCOME:

Student will be able to

CO1: Know the concept, types and general principles of Fibre optic instrumentation.
CO2: Study the concept of Laser technology and its usage in Instrumentation.
CO3: Understand the concept and application of microcontroller based instrumentation.
CO4: Get an idea for the usage of smart instruments in process industries.
CO5: Have an idea about the utilization of virtual instruments in industries.

FIBRE OPTIC INSTRUMENTATION

Fiber optics sensors - fiber optic instrumentation system -Different types of modulators – detectors - Interferometer method of measurement of length - moire fringes - measurement of pressure, temperature, current, voltage, liquid level and strain - fiber optic gyroscope-polarization maintaining

LASER INSTRUMENTATION
Laser for measurement of distance, length, velocity, acceleration, current, voltage, atmospheric effect - material processing - laser heating, welding, melting and trimming of materials - removal and vaporization

MICROPROCESSOR BASED INSTRUMENTATION
Hardware and firmware components of a microprocessor system - micro controllers - multiple processors - An example application of a microprocessor system -calibration and correction - human interface - computer interface - software characteristics of the computer interface - numerical issues - Embedded programming issues

SMART INSTRUMENTS
Smart/intelligent transducer-comparison with conventional transducers-self diagnosis and remote Calibration features-Smart transmitter with HART communicator-Measurement of strain, flow, and pH with smart transmitters

VIRTUAL INSTRUMENTATION
Block diagram and architecture of the virtual instrumentation - VIs and sub VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O

TEXT BOOKS
1. Chapman P., Smart Sensors, ISA Publications,1995
2. Jasprit Singh, Semiconductor Opto-electronics, McGraw Hill, 1995

REFERENCES
1. Lisa K. Wells & Jeffrey Travels, Labview for every one, Prentice Hall, 1999
2. Sokoloff, Basic concepts of Labview 4, Prentice Hall 1998.

		L	T	P	C
ICE5012	**BIO MEDICAL INSTRUMENTATION**	3	0	0	3

PRE-REQUISITE: EIE201, EIE281, EIE303
OBJECTIVES :

- This course gives knowledge of the principle of operation and design of biomedical instruments. It attempts to render a broad and modern account of biomedical instruments.
- It gives the introductory idea about human physiology system which is very important with respect to design consideration
- Understand the functional components of various instruments
- Suggest a range of methods which are used to diagnose, monitor or manage conditions.

COURSE OUTCOME:
CO1: Students will have a clear knowledge about human physiology system.

CO2: They will have knowledge of the principle operation and design and the background of biomedical instruments and specific applications of biomedical engineering.
CO3: Electrical safety: physiological effects of electricity, macro- and microshock hazards, protection, electrical safety codes and standards
CO4: Measurement of flow and volume of blood
CO5: Describe situations when CT imaging is preferred to MRI imaging.

BASIC CONCEPTS OF BIO MEDICAL INSTRUMENTATION
Terminology – Generalized medical instrumentation system – Measurement constrains – Classification – Interfacing and modifying inputs – Bio statistics – Static and dynamic characteristic – Regulation of medical devices – Electrical safety in medical environment

BASIC SENSORS AND SIGNAL PROCESSING
Displacement measurements – Resistive sensors – Bridge circuits – Inductance, capacitance and piezo electric sensor – Temperature measurements – Thermocouples – Radiation thermometry – Fiber optic temperature sensors – Optical measurements – Op-amp circuits – Phase sensitive demodulation – Oscillographic, galvanometric and potentiometric recorders – Microcomputers in bio medical instrumentation

BIO POTENTIALS AND MEASUREMENTS
Electric activity and excitable cells – Functional organization of peripheral nervous system. ENG, EMG, ECG, EEG & MEG – Bio-potential electrodes – Electrolyte interface. Polarization – Body surface recording electrodes – Electrodes for electric simulation of tissues – Practical hints for using electrodes – Bio potential amplifiers

BLOOD PRESSURE, FLOW AND SOUND MEASUREMENT
Direct and indirect blood pressure measurement and analysis – Bandwidth requirement – Typical waveforms – Phono-cardiography – Tonometry – Electro magnetic and ultrasonic flow meters – Photo plethysmography

CLINICAL MEASUREMENT AND IMAGING SYSTEMS
Respiratory instruments – Transducers, spirometers, pulmonary measurements and instruments – Oxymeter – Laser application in medicines – Pulsed ruby, Nd Yag, Argon and Carbon-dioxide lasers – X-ray machines – Fluoroscopic machines, thermogram equipments – Ultrasonic imaging – Scanning methods and applications – Image evaluation and processing in medical field – Artificial assist devices

TEXT BOOKS
1. Khandpur R. S., “Handbook of Bio-medical Instrumentation”, Tata McGraw-Hill Publication Company, 1989
2. All Evans, “The Evaluation of Medical Images”, Adam Hilger publication, 1981

REFERENCES
1. Dean D. E. Marre A., “Bio electronic Measurements”, Prentice Hall, 1983
2. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and Sons, 1999
3. Cromwell. L. Fred J. Webbell, “Bio medical Instrumentation and Measurements”, Prentice Hall, 1995

ICE5013	COMPUTER AIDED ANALYSIS AND DESIGN OF SYSTEMS	L	T	P	C
		3	0	0	3

PRE-REQUISITE

To gain knowledge in compensator and controller design, state variable analysis, non-linear systems and optimal control.

OBJECTIVES:

The objective of this course is to expose students to the methods of control engineering that emerged in the field during the past 5 decades. As the industry is geared towards adopting these methods to build large scale and complex systems, this course prepares the student to take up such challenges in his profession.

COURSE OUTCOME:

Upon completing the course, the student should have

CO1: Understand the concept of physical system and algorithm for system simulation.

CO2: Analyze the system using system design.

CO3: Understand the simulation of control system.

CO4: Perform closed loop control system.

CO5: Synthesis the controller in various controller software programming.

ALGORITHM FOR SYSTEM SIMULATION

Linear and Non linear equation – solution – computation algorithm – transfer function and state space model – realization – simulation – properties

CONTROLLER DESIGN

Algorithms for developing Bode – Nyquist – polar plots- optimisation – controller design – system performance evaluation

SIMULATION OF PHYSICAL SYSTEMS

Simulation of Electrical – Mechanical – Hydraulic – Thermal – Process systems

CLOSED LOOP OPERATION

Design of controllers – sensor dynamics – noise generation – closed loop simulation

SYMBOLIC PROGRAMMING

Introduction- Symbolic programming – programming constructs – data structure – computation with formulae - procedures – numerical programming

TEXT BOOKS

1. Chen, "System and signal analysis", second edition , oxford university press, 1994.
2. Dorf and Bishop, "Modern control engineering", Addison Wesley, 1998

REFERENCES

1. Ogatta.K., Modern control Engineering , 4th edition, Pearson education 2002
2. MATLAB/ SIMULINK user manual, MATHCAD / VIS SIM user manual

		L	T	P	C
ICE5014	**DIGITAL SIGNAL PROCESSORS**	3	0	0	3

PRE-REQUISITE: MAT201, EIE206, MAT211

COURSE OBJECTIVES :

To familiarise the students with

- The basic concepts and techniques for processing signals on a computer.
- Signals, systems, time and frequency domain concepts which are associated with the mathematical tools. ie fundamental to all DSP techniques.
- To provide a thorough understanding and working knowledge of design, implementation, analysis and comparison of digital filters for processing of discrete time signals.

- To study various sampling techniques and different types of filters and will also understand basic principles of estimation theory.
- The most important methods in DSP, including digital filter design, transform-domain processing and importance of signal processors.

COURSE OUTCOME:

Students will be able to,

CO1: Understand about types of processor.

CO2: Design and analyze circuit using TMS 320C5X processor for specific applications.

CO3: Design and analyze circuit using TMS 320C54X processor for specific applications.

CO4: Program using different types of processor for specific applications.

CO5: Program in high performance processor for different applications.

INTRODUCTION

Introduction to Programmable Digital Signal Processors – Basic architecture of DSPs

TMS 320C5X - TEXAS PROCESSORS

TMS 320C5X – Architecture - Assembly language instructions – Pipelining – Applications

TMS 320C54X - TEXAS PROCESSORS

TMS 320C54X –Architecture - Assembly language instructions – Pipelining – Applications

PROGRAMMING OF PROCESSORS

Assembly language instructions-Pipelining-Applications

HIGH PERFORMANCE PROCESSORS

An Overview of TMS 320C6X - An Overview of TMS 320C6X - An Overview of Motorola DSP 563XX Processors

TEXT BOOKS

1. B. Venkataramani et al. “Digital Signal Processor – Architecture, Programming and Applications”, TMH, New Delhi 2002

REFERENCES

1. K. Padmanabhan et al. “A Practical approach to Digital Signal Processing”, New Age Publications, 2001
2. Texas Instruments – Manuals.

ICE5015	OPTIMAL AND ADAPTIVE ONTROL	L	T	P	C
		3	0	0	3

PRE-REQUISITE

To provide a knowledge of existing algorithms for adaptive control, with a basic understanding of their stability properties and of how to implement them.

COURSE OBJECTIVE:

- To introduce the theory of optimal control and its applications.
- To provide knowledge of dynamic optimization
- To deal with design optimal control system

COURSE OUTCOME:

Upon the successful completion of course student can be able to:

CO1: Apply optimal control concepts to systems.
CO2: Use dynamic optimization techniques to controllers.
CO3: Design optimal control algorithms for real time systems.
CO4: Understand the adaptive controller strategy

PROBLEM FORMULATION
Mathematical model – Physical constraints - Performance measure Optimal control problem. Performance measures for optimal control problem. Selection a performance measure

DYNAMIC PROGRAMMING
Optimal control law – Principle of optimality. - An optimal control system. A recurrence relation of dynamic programming – computational procedure. Characteristics of dynamic programming solution. Hamilton – Jacobi – Bellman equation. Continuous - linear regulator problems

CALCULUS OF VARIATIONS
Fundamental concepts. - Functionals. Piecewise – smooth extremals Constrained extrema

VARIATIONAL APPROACH TO OPTIMAL CONTROL PROBLEMS
Necessary conditions for optimal control – Linear regulator problems. Linear tracking problems. - Pontryagin's minimum principle and state inequality constraints

ADAPTIVE CONTROL-CLASSIFICATION
MRAC systems – Different configuration, classification, mathematical description – direct and indirect MRAC – self tuning regulator – different approach to self tuning, recursive parameter estimation, implicit and explicit STR

TEXT BOOKS
1. Donald E. Kirk, Optimal Control Theory: An Introduction, Prentice-Hall networks series, 1970
2. Chalam V. V, Adaptive control systems Marcel Dekker, INC New York and Bassel, 1987

REFERENCES
1. Anderson .B. D. O, Moore .J. B, Optimal control linear Quadratic methods, Prentice Hall of India, New Delhi, 1991
2. Sage A. P, White .C. C, Optimum Systems Control, Second Edition, Prentice Hall, 1977
3. Astrom K. J., and Wittenamrk B. Adaptive control, Addison Wesley Publishing Co. USA, 1989

ICE6001	ADVANCED POWER SEMICONDUCTOR DEVICES	L	T	P	C
		3	0	0	3

PRE – REQUISITE:

Knowledge of basic electronics is required.

OBJECTIVES:
- To provide comprehensive knowledge of instrumentation in the design, analysis and control point of view.
- Gaining knowledge to design an power circuits.

COURSE OUTCOME:
Student will be able to
CO1: Understand the concept of power electronic devices such as power diode and switching devices.
CO2: Design a current controlled switching circuitry to the relevant applications.

CO3: Design a voltage controlled switching circuitry to the relevant applications
CO4: Understand the firing and protection circuits.
CO5: Design thermal production to the power electronic circuits.

INTRODUCTION
Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating

CURRENT CONTROLLED DEVICES
BJT's – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power darlington - Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor

VOLTAGE CONTROLLED DEVICES
Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT, FCT, RCT and IGCT

FIRING AND PROTECTING CIRCUITS
Necessity of isolation, pulse transformer, optocopler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers

THERMAL PROTECTION
Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types

TEXT BOOKS
1. Mohan, Undcland and Robins, Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000
2. Rashid M. H., Power Electronics Circuits, Devices and Applications , Prentice Hall India, Third Edition, New Delhi, 2004
3. MD Singh and K. B Khanchandani, Power Electronics, Tata McGraw Hill, 2001

		L	T	P	C
ICE6002	**NEURAL NETWORK AND FUZZY LOGIC CONTROL**	3	0	0	3

PRE-REQUISITE:
Students are required to be familiar with Basic concepts in controller design and Matrices.

OBJECTIVES:
To learn the design, tuning, and development of ANN &Fuzzy Logic Controllers (FLC)
To acquire basic understanding of the various algorithms involved in Neural Networks, Genetic & Fuzzy logic
To apply the intelligent controller in process control application.

COURSE OUTCOME:

Upon the completion of this subject, the student will be able to

CO1: The concepts of feed forward neural networks and learning and understanding of feedback neural networks.

CO2: Concept of fuzziness involved in various systems and fuzzy set theory.

CO3: Comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic.

CO4: Adequate knowledge of application of fuzzy logic control to real time systems.

INTRODUCTION AND DIFFERENT ARCHITECTURES OF NEURAL NETWORKS

Artificial neuron – MLP – Back propagation – Hope field networks – Kohonen self organising maps – adaptive resonance theory

NEURAL NETWORKS FOR CONTROL

Schemes of neuro-control – identification and control of dynamical systems – adaptive neuro controller – case study

INTRODUCTION TO FUZZY LOGIC

Fuzzy sets – fuzzy relations – fuzzy conditional statements – fuzzy rules – fuzzy algorithm

FUZZY LOGIC CONTROL SYSTEM

Fuzzy logic controller – fuzzification interface – knowledge base – decision making logic – defuzzification interface – design of fuzzy logic controller – case study

APPLICATIONS

Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox., Optimisation of membership function and rules base of fuzzy logic controller using neural network tool box – genetic algorithm – fuzzy neuron – adaptive fuzzy systems – case study

TEXT BOOKS

1. Jacek M. Zurada, Introduction to artificial Neural Systems, Jaico Publishing House Mumbai, 1997
2. Timothy. J. Ross, Fuzzy logic with Engineering Applications, Tata Mc-Graw Hill,1997

REFERENCES

1. Laurance Fausett, Fundamentals of Neural Networks, Prentice Hall, Englewood cliffs, N.J, 1992
2. Zimmermann H. J., Fuzzy set theory and its applications, Allied Publication Ltd., 1996
3. Tsoukalas L. H, and Robert E.Uhrig, Fuzzy and Neural approach in Engineering, John Wiley and Sons, 1997
4. Klir G. J and Yuan B.B, Fuzzy sets and fuzzy logic, Prentice Hall of India, New Delhi, 1997
5. Driankov D, Hellendron. H. Reinfrank M., An Introduction to Fuzzy control, Narosa publishing House, New Delhi, 1996
6. Millon W. T., Sutton R. S. and Webrose P. J, Neural Networks for control, MIT, Press, 1992

ICE6003	**DIGITAL IMAGE PROCESSING**	L	T	P	C
		3	0	0	3

PREREQUISITES:

Mathematics III (MAT202),Mathematics IV (MAT222).

COURSE OBJECTIVES:

To understand the theoretical knowledge of digital image processing techniques and applications

COURSE OUTCOMES:
CO1: Acquire the fundamental concepts of a digital image processing system.
CO2: Learn different image transforms techniques
CO3: Apply image enhancement techniques.
CO4: Understand the concept of restoration techniques.
CO5: Analyze and compress given images using segmentation techniques.

DIGITAL IMAGE PROCESSING SYSTEMS, VISUAL PERCEPTION & IMAGE MODEL
Image acquisition, storage, processing, communication and display, Structure of human eye, image formation in the human eye, brightness, adaptation and discrimination.Uniform and non-uniform sampling and quantization

DISCRETE 2-D LINEAR PROCESSING & IMAGE TRANSFORMS
Superposition and convolution, unitary transforms linear processing techniques.2-D DFT / FFT, Walsh, Hadamard Transforms, Discrete Cosine and Sine transforms,Haar Transform, Slant Transform, Hotelling Transform

IMAGE ENHANCEMENT
Contrast manipulation, Histogram modification, noise cleaning, edge sharpening,frequency domain methods like low-pass and high-pass filtering, homomorphic filtering

IMAGE SEGMENTATION
Detection of discontinuity, point line and edge detection, edge linking and boundary detection, thresholding, image interpretation

IMAGE COMPRESSION
Coding redundancy. Psycho-visual redundancy. Fidelity criteria, MSE, fundamental coding theorem. Error -free compression, variable length coding .bit plane coding. Loss- less predictive coding. Lossy predictive coding, Transform coding, DPCM, OM, ADM

TEXT BOOKS
1. Pratt.W., Digital Image Processing, Wiley Publication, 3rd edition,2002
2. Gonzalez & Woods, Digital Image Processing, Pearson Education, 2nd edition, 2003

REFERENCES
1. Jain.K., Fundamentals of Image processing; Prentice Hall of India Publication, 1995

ICE6004	PROCESS DYNAMICS & CONTROL	L	T	P	C
		3	0	0	3

PRE-REQUISITE:

Knowledge of system transfer function, control action, controllers and final control element is required.

COURSE OBJECTIVES:

- To study the basic characteristics of first order and higher order processes.

- To get adequate knowledge about the characteristics of various controller modes and methods of controller tuning.
- To study about various complex control schemes.
- To study about the construction, characteristics and application of control valves.

COURSE OUTCOME:

CO1 - The students can get good knowledge about mathematical modeling, controllers, final control elements and tuning processes.

CO2: Apply fundamental knowledge of mathematics to modeling and analysis of fluid flow, level, pressure, temperature problems.

CO3: Conduct experiments in pipe flows and open-channel flows and interpreting data from model studies to prototype cases. Documenting them in engineering reports.

CO4: Understand the possible disasters caused by an incorrect Design/Analysis in hydraulic, pneumatic engineering system.

REVIEW OF PROCESS AND CONTROL SYSTEMS
Control Systems, Process control principles, servomechanism, Process control block diagram, identification of elements, Mathematical model of liquid process, gas process, flow process, thermal process, mixing process - Batch process and continuous process - Self regulation

DESIGN ASPECTS OF PROCESS CONTROL SYSTEM
Classification of variables, Design elements of a control system, control aspects of a process. The input – output model, degrees of freedom and process controllers. Modes of operation of P, PI and PID controllers. Effect of variation of controller variables. Typical control schemes for flow, pressure, temperature and level processes

CONTROL SYSTEM COMPONENTS
I/P and P/I converters - Pneumatic and electric actuators - valve positioner - control valve Characteristics of control valve - valve body - globe, butterfly, diaphragm ball valves - control valve sizing - Cavitation, flashing in control valves - Response of pneumatic transmission lines and valves. Actuators – Pneumatic, Hydraulic, Electrical/ Electronic

DYNAMIC BEHAVIOR OF FEEDBACK CONTROLLED PROCESS
Stability considerations. Simple performance criteria, Time integral performance criteria: ISE, IAE, ITAE, Selection of type of feedback controller

ADAPTIVE CONTROL
Gain Scheduling Adaptive Control, Model – reference adaptive control, self tuning regulator. Logic of feed forward control, problems in designing feed forward controllers, feedback control, Ratio Control, Cascade Control, Elective Control systems: Over ride control, auctioneering control, split range control. Processes with large dead time. Dead time compensation. Control of systems with inverse response

TEXT BOOKS:

1. Stephanopoulis.G., Chemical Process Control, Prentice Hall of India, New Delhi, 2nd edition, Reprint 2002
2. Eckman. D.P., Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993

REFERENCES

1. Harriott. P., Process Control, Tata McGraw Hill Publishing Co., New Delhi, 1991
2. Shinkey., Process Control Systems., IV Edition., Tata Mcgraw Hill., New Delhi., 1996

ICE6005	RELIABILITY & SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

PRE-REQUISITE:

Knowledge of system reliability EIE306,EIE201,EIE313.

COURSE OBJECTIVES:

To provide in depth knowledge about the concept of reliability.
To impart knowledge on various reliability prediction models
To learn about various techniques for improving reliability in industries.
To develop knowledge on risk assessment study.

COURSE OUTCOMES:

After completion of this course the students can be able to:
CO1: know about various failure modes of equipment and their effects.
CO2: Maintain reliability by reducing failure time in Industry to maintain safety and productivity.
CO3: Understand about various reliability models.
CO4: Conduct risk assessment study in industries
CO5: Apply the safety concept in industrial sectors.

RELIABILITY

Definition and basic concepts, failure data, failure modes, reliability in terms of hazard rates and failure density function. Hazard models and 'bath-tub' curve. Applicability of Weibull distribution. Reliability calculation for series, parallel series and K-out of M systems

USE OF REDUNDANCY AND SYSTEM RELIABILITY IMPROVEMENT METHODS

Objectives, types of maintenance , preventive, condition-based and reliability centered maintenance.Terotechnology, Total Productive Maintenance (TPM)

MAINTAINABILITY

Definition, basic concepts, relationship between reliability, maintainability and availability, corrective maintenance time distributions and maintainability demonstration. Design considerations for maintainability

INTRODUCTION TO LIFE-TESTING

Destructive and non-destructive tests , estimation of parameters for exponential and Weibull distributions, component reliability and MIL standards

SAFETY

Causes of failure and unreliability, measurement and prediction of human reliability, human reliability and operator training - Reliability and safety: Safety margins in critical devices. Origins of consumerism and importance of product knowledge, product safety, product liability and product safety improvement program

TEXT BOOKS

1. Govil A. K, Reliability Engineering, Tata McGraw Hill, New Delhi, 1983

REFERENCES

1. Sinha and Kale, Introduction to Life-Testing, Wiley Eastern, New Delhi, 1992
2. Wisley et al, Human Engineering Guide for Equipment Designers, University of California Press, California, 1973

ICE6006	MICRO-CONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To learn the Architecture, addressing modes and instruction set of micro controller.
2. To learn the programming concepts of microcontroller.

COURSE OUTCOMES:

After going through this course the student will be able to

CO1: understand the role of micro controller in industrial applications.

CO2: Understand the basic resources needed for microcontroller.

CO3. Design and implement microcontroller based systems.

CO4:Understand the Hardware and software interaction and integration

ROLE OF MICRO-CONTROLLERS

Types and selection – Application example

8051 ARCHITECTURE

Basic Organization – Timing Diagrams (Fetch And Execute Cycle) – Instruction Set- Basic Operations, Addressing Modes

PERIPHERALS AND THEIR INTERFACING

Typical Bus Structure – Bus- Memory - Timing Characteristics - Extended Mode And Memory Interfacing - Polling - Interrupts- Serial Ports- Analog And Digital Interfaces.

COMPUTATION

Assembly Language- Simple Programs- Usage of Timers- Generation of PWM, Other Signals- Interfacing Basic I/O Devices

8096 ARCHITECTURE

CPU Operation – Interrupt Structure – Timers – HSI / HSO - Analog Interface – Serial Ports- I/O Ports - Watchdog Timers

CASE STUDY

Real Time Clock- DC Motor Speed Control- Generation Of Gating Signals For Converters And Inverters- Frequency Measurement – Temperature Control.

TEXT BOOKS

1. John B. Peatman, Design with micro - controllers, Mc-Graw Hill International Ltd, Singapore, 1989
2. Muhammad Ali Mazidi, Janice Gillispie mazidi. The 8051 Microcontroller and Embedded systems, Pearson Education, 2004

REFERENCES

1. Intel manual on 16 bit embedded controllers, Santa Clara, 1991.

2. Myko Predko. Programming and customizing the 8051 microcontroller, Tata Mcgrawhill , 1999.
3. Michael Slater, Microprocessor based design , A Comprehensive guide to effective hardware design, Prentice Hall, New Jersey, 1989.

ICE6007	**ADVANCED SENSOR TECHNOLOGY**	L			
		3	0	0	3

PRE-REQUISITE:

c. Fundamentals of Basic Engineering
d. Basic Knowledge in measurements
e. Basic Idea about sensors

COURSE OBJECTIVES:

To learn about

f. Measurement Systems
g. Working and applications of Various Transducers

COURSE OUTCOME:

After successful completion of the course students can be able to:

CO1: Understand the application of different chemical sensors for chemical process industry.

CO2: Apply the principles of optic fiber system and mode of light transfer to the various applications.

CO3: Apply the different sensors to the various biomedical applications.

CO4: Understand the different type of electrodes and its usage.

CHEMICAL SENSORS

Physical Sensors – Surface Micro Machined Capacitive Pressure sensor, Integrated flow sensor, Chemical and Biochemical Sensors – Conductivity sensor, Hydrogen Sensitive MOSFET, Tri-Oxide Sensors, Schottky diode type sensor, Solid Electrolyte, Electrochemical Sensors. Sensor Matrix for Two dimensional measurement of concentrations

OPTICAL SENSOR

Holography, Echolocation and bio holography, Sensors used in space and environmental applications. Application in meterorology, natural resources application sensor used in Instrumentation methods

BIOMEDICAL SENSORS

Biological Sensors in Human Body – Different types of Transducer system – Physiological Monitoring – chemo receptors – Hot and cold receptors – sensors for smell, sound, vision taste

ELECTRODES

pH –EEG – ECG , EMG, Bio sensors – Plethysmography, Instruments based on knot of sound. Ultrasonic Transducers for Measurement and therapy – radiation detectors – NIR spectroscopy – NMR . MRI

ADVANCED SENSOR DESIGN

Sensor design a sensor characteristics, Design of signal conditioning devices for sensors. Design of 2& 4 wire transmitters with 4 – 20 mA output. Pressure Sensor using SiSi bonding, Catheter pressure sensors, TIP pressure sensors, High pressure sensors, Silicon accelerometers.Aerospace Sensor-Gyroscope laser and fibre optic gyroscopes, accelerometers. Laser, Aerospace application of laser, Resolvers, Altimeters, Angle of attack sensors, servos

TEXT BOOKS

1. Sabaree Soloman, Sensors Hand Book, McGraw Hill , 1998
2. Carr and Brown, Introduction to Medical Equipment Technology, Addison Wesley, 1999

REFERENCES

1. Smith H. M. Principles of Holography, John Wiley & Sons, New York, 1975
2. J. G. Webster, Medical instrumentation Application and Design, Houghton Mifilin Co

3. Culshaw .B and Dakin J (Eds), Optical Fibre Sensors, Vol. 1 & 2 Artech House,Norwood, 1989
4. P. Garnell – Guided Weapon Control Systems – Pergamon Press, 1980

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ICE6008	**VIRTUAL INSTRUMENTATION**	3	0	0	3

PREREQUISITE

Concepts of Data Acquisition Systems and Basics of LabVIEW Programming

COURSE OBJECCTIVES

- To know about virtual versus traditional instruments, programming techniques
- To know about A/D and D/A converter and data acquisition.
- To know about PC buses, Instrumentation buses and network protocols.
- To design using VI software of controllers To know about PC operating system and instrumentation

COURSE OUTCOMES

CO1: Develop ability for programming in LabVIEW using various data structures, program structures, plotting the graphs and charts for system monitoring, processing and controlling

CO 2: Understand the basics of interfacing and programming using related hardware

CO 3: Understand the interfacing of DAQ devices and customized user designed hardware with Lab VIEW

CO 4: Acquire knowledge about implementation and designing of Machine Vision and motion control

CO 5: Write the Certified LabVIEW Associate Developer (CLAD) exam, administered by National Instruments, for the certification and leading to placements in core companies

REVIEW OF VIRTUAL INSTRUMENTATION

Historical perspective, advantages - block diagram - architecture of a virtual instrument

DATA – FLOW TECHNIQUES

Graphical programming in data flow - comparison with conventional programming

VI PROGRAMMING TECHNIQUES

VIs - sub-VIs - loops - charts, arrays - clusters – graphs - case - sequence structures - formula nodes - local - global variables - string - file I/O

DATA ACQUISITION AND INSTRUMENT INTERFACE

ADC – DAC – DIO - counters – timers - PC hardware structure – timing – interrupts – DMA - software - hardware installation - current loop - RS 232/RS485 – GPIB - USB - PCMCIA

ANALYSIS TOOLS AND APPLICATION

Some tools from the advanced analysis tools revalent to the discipline may be included e.g. Fourier Transform - power spectrum - correlation methods - windowing – filtering - VI applications in various fields – VISA - IVI – Image acquisition and processing

TEXT BOOKS

1. Sokoloff, Basic Concepts of lab view 4, Prentice Hall, 1998
2. S. Gupta, J. P. Gupta, PC interfacing for Data Acquisition & Process Control, 2nd Edition, Instrument Society of America, 1994

REFERENCES

1. Gary Johnson, Lab view graphical programming, 2nd Edition McGraw Hill, 1997
2. Lisa K Wells & Jeffrey Travels, Lab view for everyone, Prentice Hall, 1997

ICE6011	FAULT DIAGNOSIS AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OUTCOME:

Upon the successful completion of the course the students can be able to:

CO1: Understand the different Fault Detection and Diagnosis methods

CO2: Design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach

CO3: Design and detect faults in sensor and actuators using GLR and MLR based Approaches

CO4: Understand various types of fault tolerant control schemes such as Passive and active approaches

CO5: Detect and quantify and compensate stiction in Control valves

INTRODUCTION

Introduction- Definition for fault-fault detection and diagnosis-Process monitoring procedures-process monitoring measures-monitoring

MULTIVARIATE STATISTICS AND PATTERN CLASSIFICATION

Data pre-treatment-Univariate statistical monitoring-T^2 Statistic- threshold for T^2 Statistic- Data requirement- Discriminant analysis- feature

DATA DRIVEN METHODS

Principal Component analysis- Reduction order-fault detection, identification, diagnosis, Dynamic PCA and other methods- Fisher Discriminant Analysis- Partial least squares-Canonical Variate analysis

ANALYTICAL AND KNOWLEDGE-BASED METHODS

Fault description- Parameter estimation- Observer based methods- Parity relations- Casual analysis-Expert system- Pattern- Combination of various techniques

APPLICATIONS

Tennessee Eastman Process- Application description- Case studies results and discussion

TEXT BOOKS

1. L.H.Chiang, E.L.Russell and R.D Braatz,“Fault Detection and Diagnosis in Industrial Systems”, Springer, 2000.

REFERENCE BOOKS

1. George Vachtsevanos, Frank L.Lewis, Michael Roemer, Andrew Hess, “Intelligent Fault Diagnosis and Prognosis for Engineering Systems”, Wiley, 2006s, 1987.
2. Computational Intelligence in Fault Diagnosis(Advanced Information and Knowledge Processing) Springer, 2006.
3. Krzysztof Patan, “Artificial Neural Networks for Modelling and Fault Diagnosis of Technical Processes”, Springer, 2008-07.