VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY

BURLA, SAMBALPUR, ODISHA-768018

DEPARTMENT OF ELECTRICAL ENGINEERING

MISSON OF THE DEPARTMENT

To produce Electrical Engineers with dynamic well rounded personalities adaptable to ever increasing demands of emerging technologies involving analytical and practical skills.

VISION OF THE DEPARTMENT

- To develop the department as a renowned academic center of learning in the discipline of Electrical Engineering.
- To establish research and development center of repute so as to encourage active participation with industry by staff and students to take on practical problems of industry and to provide feasible solutions.
- To establish tie-ups with institutions of national and international repute and to foster building up of a wide knowledge base to keep in tune with ever increasing demands of technologies.
- Developing simple, appropriate technologies, which will be instrumental in the up-liftment of rural society.

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY

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DEPARTMENT OF ELECTRICAL ENGINEERING

MASTER OF TECHNOLOGY IN *CONTROL AND INSTRUMENTATION ENGINEERING*

PROGRAMME EDUCATIONAL OBJECTIVES

1. To strengthen the knowledge in the domain of control and instrumentation engineering and thereby enhance the employability of the graduates in public/private organization and Institutes.
2. To develop the graduate who have the ability to identify and address current problems in the domain of control and instrumentation engineering.
3. To inculcate research attitude and lifelong learning among the graduates.

VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY

BURLA, SAMBALPUR, ODISHA-768018

DEPARTMENT OF ELECTRICAL ENGINEERING

MASTER OF TECHNOLOGY IN *CONTROL AND INSTRUMENTATION ENGINEERING*

PROGRAMME OUTCOMES

a) Acquire in-depth knowledge in the domain of control and instrumentation Engineering.

b) Analyzing ability for abstracting information for preparation of the system models and ability to critically analyze the system models.

c) Understand various control strategies and their applications for various types of systems.

d) Demonstrate control design capability.

e) Demonstrate implementation skills using advanced software and embedded tools.

f) Demonstrate capability to design and develop the ideas for solving problems in the field of control and instrumentation engineering.

g) Independent and reflective learning while developing project.

h) Manage to work in the team.

i) Explore ideas and lifelong learning in the domain of control and instrumentation engineering.

j) Capability of dissemination of knowledge on national and International level.

k) Professional and ethical value addition.

Master of Technology in Control & Instrumentation Engineering (Two Years Regular Course) 2016

First (Autumn) Semester:

Sub No.	Subjects		L	T	P	C
MEE2121	Instrumentation		3	1	0	4
MEE2108	Advanced Control System		3	1	0	4
MEE2105	Advanced Digital Signal Processing		3	1	0	4
	Elective – I(Any two)		3+3	1+1	0	4+4
MEE2171	Instrumentation & Control Lab		0	0	6	4
MEE2172	Seminar – I		0	0	3	2
MEE2173	Comprehensive Viva Voce-I					2
	Total		15	5	9	28

Second (Spring) Semester:

Sub No.	Subjects	L	T	P	C
	CAD of Instrumentation system	3	1	0	4
	Industrial communication system	3	1	0	4
	Non-linear control	3	1	0	4
	Elective – II(Any two)	3+3	1+1	0	4+4
	Process control lab	0	0	6	4
	Seminar – II	0	0	3	2
	Comprehensive Viva Voce-II				2
	Total	15	5	9	28

Third (Project) Semester:

Sub No.	Subjects	L	T	P	C
	Dissertation interim evaluation	0	0	0	10
	Seminar on Dissertation	0	0	0	3
	Comprehensive Viva	0	0	0	2

Total 15

Fourth (Project) Semester:

Sub No.	Subjects	L	T	P	C
	Dissertation Open Defence	0	0	0	5
	Dissertation evaluation	0	0	0	20

Total25

Elective – I in First Semester:

Microprocessor& Microcontroller Based System
Electronics Device & Systems
Biomedical Instrumentation
Internet for Measurement and Control
Instrumentation for environmental analysis

Elective – II in Second Semester:

Process Control and Instrumentation
Adaptive control
Robotics
Remote sensing and control
Embedded system and design

(1st Semester)
INSTRUMENTATION (3-1-0)

Course Objectives

1. To elaborate different concepts of Instrumentation engineering like different transducers, their dynamic and static characteristics, errors in measurement.
2. To introduce the students with the basic knowledge of construction, applications, principles of operation of various sensors & transducers.
3. To get the basic and design knowledge of various signal conditioning circuits.
4. To introduce the students regarding signal transmitters, electromagnetic interference and filtering and shielding against it.
5. To introduce students about hazardous areas and classification, safety practice, NEMA standards and Protection methods used in industries

MODULE-I

General concepts and terminology of measurement systems, static and dynamic characteristics, sample mean, sample standard deviation, error probability density function, Least squares calibration curves,2-σ limits in defining Imprecision standards and calibration. Introduction, principle, construction and design of RTD, Thermocouple, Thermister, Strain Gauge, piezoelectric transducer, Capacitive pickups, Variable-Inductance & Variable –Reluctance pickups, seismic absolute velocity & acceleration pickups, Vibration Transducer, LVDT.

MODULE-II

Introduction to semiconductor Temperature,Humidity, Pressure Transducer and its applications.

Design of resistive deflection bridges for strain gauges, thermistor, thermometer, Design of reactive deflection bridges, Operational amplifier,Instrumentation amplifier,Charge amplifier& Impedance converters, A.C carrier systems, Filters,Analog to Digital conversion: sampling, quantization, encoding, converters, Integrator & Differentiator.

MODULE-III

Introduction to transmitters, two wire and four wire transmitters, Smart and intelligent Transmitters, Design of transmitters.

Introduction to EMC, interference coupling mechanism, basics of circuit layout and grounding, concept of interfaces, filtering and shielding.

MODULE-IV

Safety: Introduction, electrical hazards, hazardous areas and classification, non-hazardous areas, enclosures – NEMA types, fuses and circuit breakers. Protection methods: Purging, explosion proofing and intrinsic safety.

TEXT BOOKS:

1. John P. Bentley, Principles of Measurement Systems, Third edition, Addison Wesley Longman Ltd., UK, 2000.
2. Doebelin E.O, Measurement Systems - Application and Design, Fourth edition, McGraw-Hill International Edition, New York, 1992.

REFERENCES BOOKS:

1. M. Sze, "Semiconductor sensors", John Wiley & Sons Inc., Singapore, 1994.
2. Noltingk B.E., "Instrumentation Reference Book", 2nd Edition, Butterworth Heinemann, 1995.
3. L.D.Goettsche, "Maintenance of Instruments and Systems – Practical guides for measurements and control", ISA, 1995.

Course Outcomes:

Upon successful completion of this course, a student should be able to:

1. Know the application of different transducers, calculation of errors in measurement.
2. Design various signal conditioning circuits for sensors & transducers.
3. Understand signal transmitting circuits, filtering and shielding against Electromagnetic Interference.
4. Classify various Hazardous area, identify suitable enclosure type electrical equipment for the hazardous area, understand protection methods.

(1st Semester)

ADVANCED CONTROL SYSTEM (3-1-0)

Course objectives

1. The purpose of this course is to introduce the key concepts in advanced control systems for SISO as well as MIMO systems.
2. Digital control techniques are to be described
3. The students should be able to characterize and tune different adaptive controllers
4. The purpose is to give up-to-date knowledge for designing controllers for non-linear systems.

MODULE-I

SISO Control Analysis and Design Analysis of SISO Control Loops, Classical PID Control, Synthesis of SISO Controllers, Fundamental Limitations in SISO Control, Model error Limitations, Structural Limitations, Frequency Domain design limitations, Architectural Issues in SISO Control, Internal Model Principle, Feed forward and Cascade Control, Anti-wind-up scheme, Introduction to Model Predictive Control

MODULE-II

Digital Computer Control, Models for sampled Data Systems, Sample Data Design, Internal Model Principle for Digital Control, Models for hybrid Control, Systems, Analysis of Inters ample behaviour.

MODULE-III

Advanced SISO Control. SISO controller Parameterizations, Control Design Based on Optimisation, Synthesis via state space methods, Introduction to Nonlinear Control.

MODULE-IV

MIMO Control Essentials, Analysis of MIMO Control Loops, Exploiting SISO Techniques in MIMO Control, MIMO Control Design: Design via Optimal control techniques, Model Predictive Control MIMO Controller Parameterizations, Decoupling

TEXT BOOKS:

1. Graham C. Goodwin, Stefan F.Graebe, Mario E.Salgado, "*Control System Design*", PHI-2002.
2. M. Athans and P. Falb, "*Optimal control*", MGH
3. K. Astrom, and B.wittenmark, "*Computer Control Systems: Theory and design*", Prentice Hall

Course Outcomes:

1. At the end of the course students will be able to apply the modeling concepts.
2. The students will learn issues of sensitivity, stability, and loop synthesis as well as feedforward and cascade structures
3. The students will learn designs for digital control and how the constraint of the trade-off web be circumvented by optimization.
4. The students will learn techniques specifically aimed at MIMO Control Problems
5. Students can apply Matlab Real Time programming/ LabVIEW to the model

Mapping of Course Outcomes to Programme Outcomes

Course Outcome	Programme Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
CO1					√			√			√
CO2					√			√			√
CO3					√			√			√
CO4											√
CO5								√	√		√

(1st Semester)
ADVANCED DIGITAL SIGNAL PROCESSING (3-1-0)

Course Objective:

1. To introduce the concept and technique associated with the understanding of Digital Signal Processing. To familiarize with techniques suitable for analysing and synthesizing Discrete time systems on the basis of Transforms.
2. To gain an understanding about Digital Filters, design and structure of digital filter.
3. To understand the concept of Finite word length effect process and errors.
4. To introduce the concept of statistical signal processing and their models.

MODULE-I

Discrete time signals, systems and their representations: Discrete time signals- Linear shift invariant systems- Stability and causality- Discrete Fourier transform- Properties of different transforms- Linear convolution using DFT- Computation of DFT

MODULE-II

Digital filter design and realization structures Design of IIR digital filters from analog filters- Impulse invariance method and Bilinear transformation method- FIR filter design using window functions.

Comparison of IIR and FIR digital filters- Basic IIR and FIR filter realization structures-Signal flow graph representations.

MODULE-III

Analysis of finite word-length effects Quantization process and errors- Coefficient quantization effects in IIR and FIR filters- A/D conversion noise- Arithmetic round-off errors- Dynamic range scaling- Overflow oscillations and zero input limit cycles in IIR filters.

MODULE-IV

Statistical signal processing Linear Signal Models All pole, All zero and Pole-zero models. Power spectrum estimation: Spectral analysis of deterministic signals. Estimation of power spectrum of stationary random signals-Optimum linear filters-Optimum signal estimation-Mean square error estimation-Optimum FIR and IIR filters.

TEXT BOOKS:

1. John G. Proakis, and Dimitris G. Manolakis, Digital Signal Processing (third edition), Prentice-Hall of India Pvt. Ltd, New Delhi, 1997

2. Alan V . Oppenheim, Ronald W. Schafer, Discrete-Time Signal Processing, Prentice-Hall of India Pvt. Ltd., New Delhi, 1997

3. A. Nagoor Kani, Digital Signal Processing(Second edition, Mc Graw Hill)
4. Sanjit K Mitra,: A computer-based approach ,Tata Mc Grow-Hill edition .1998

Course Outcome:

When the students have passed the course, they shall be able

1. To understand the fundamental concept of Digital Signal Processing, Discrete Fourier Transform and its application.
2. Apply several design techniques for IIR type digital filter, apply a design technique for FIR filter. Also understand the filter realisation structures.
3. To understand the errors of word length effect and their correction techniques.
4. To understand spectral characteristics in form of power spectral estimation.

(1st Semester)

MICROPROCESSOR AND MICROCONTROLLER BASED SYSTEMS (3-1-0)

Course objective:

The objective of this course is to provide extensive knowledge of

- Microprocessor and microcontroller based systems and its interfacing techniques and assembly language programming in 8086, Intel 8051, Intel 8096 and Motorola 68HC11.
- Architectural model of Intel 8096, Motorola 68HC11, Pentium microprocessors.
- Data transfer technique in communication media and various Bus standards.
- Concept of programming logic unit.

MODULE-I

Review of 8-bit microprocessor

16-bit microprocessor, overview of the instruction set,

Assembly language programming, Interrupt structure, interfacing memory and IO devices. Memory organizations, Standard peripherals and their interfacing (sw and hw aspects), color graphic terminals and ASCII keyboards, mouse, floppy and hard disc drive, other storage media (optical disks, Digital Audio Tapes etc.)

MODULE-II

Data transfer techniques-Asynchronous and synchronous, Serial and parallel interface standards.
Communication media and adapters, Modems and their interfacing, Bus structures and standard basic concepts, Example of a bus standard (PC-VME bus), Salient features of other processors (80286386486 or 680206803068040).
Microcontrollers and digital signal processors. IO processors and arithmetic coprocessors. Logic design for microprocessor-based systems-design of state.

MODULE-III

Introduction to Microcontrollers, Motorola 68HC11, Intel 8051, Intel 8096, Registers, Memories, I/O Ports, Serial Communications, Timers, Interrupts.

MODULE-IV

Instructions in Microcontrollers, Interfaces, Introduction to Development of a Microcontroller Based System, Concept of a Programmable Logic Controller, Features and parts in a PLC unit.

TEXT BOOKS:

1. John.F.Wakerly: Microcomputer Architecture and Programming, John Wiley and Sons.
2. Ramesh S.Gaonker: Microprocessor Architecture, Programming and Applications with the 8085, Penram International Publishing (India).
3. Yu-Cheng Liu and Glenn A.Gibson: Microcomputer systems: The 8086/8088 Family Architecture, Programming and Design, Prentice Hall of India.
4. Raj Kamal: The Concepts and Features of Microcontrollers, Wheeler Publishing.

Course Outcome:

At the end of this course, students will be able to

CO1: Understand memory organization of 16 bit microprocessor; interrupt structure and interfacing of standard peripheral devices.

CO2: Analyze the various types of data transfer technique in communication media, adapter and modem by using standard interfaces and buses.

CO3: Know the architecture and features of Intel 8096 and Motorola 68HC11microcontroller.

CO4: Realize the role of microcontroller based system and programmable logic controller.

(1st Semester)

ELECTIVE-I

ELECTRONIC DEVICES AND SYSTEMS (3-1-0)

COURSE OBJECTIVE:

1. To provide a complete knowledge of electronic devices and systems
2. The course intends to provide an overview of the principle, operation and application of the analog building blocks like diodes, BJT, FET, MOSFET etc for performance of various functions
3. To rely on elementary concept and quality analysis of the concept using simple models and appropriate equations
4. To provide discussion on amplifier and oscillators

MODULE-I

Special operational amplifiers: high voltage/high current, chopper and chopper stabilized amplifiers, instrumentation amplifier, isolation amplifier. Nonlinear function circuits: limiter, log/anti-log, multiplier/divider, peak detector, comparator, true RMS/DC converter, square wave oscillators.

Timing and counting circuits: digital counters, shift register, analog and digital timers, frequency counters, PLA and PLD applications.

MODULE-II

Sinusoidal and relaxation oscillators: phase shift, ring, Wien-bridge, tuned, quadrature oscillator, crystal oscillator and clock circuits, voltage controlled oscillators – sine, square and triangle, frequency synthesizers. Frequency-to-voltage converters: diode pump integrator, frequency and RPM transducers. Phase and phase/frequency comparators – analog and digital. Phase locked loops: linear model, loop response, applications of PLL.

MODULE-III

Power semiconductor derives: special thyristors (GTO, LASCR, Triacs etc.) BJT power MOS, IGBT, MCT, power semiconductor control circuits, SMPS, UPS, inverters, switching mode amplifier. Optoelectronic devices: photo diode/transistor, LDR, LED and LCD displays, opto-coupler, opto-interrupter, high speed detectors – PIN and avalanche photo diodes, fibre optic data link.

MODULE-IV

Active filters: types, filter approximations – Butterworth and chebyshev, filter realisations, frequency and impedance scalings, filter transformations, sensitivity, switched capacitor circuit, data conversion and acquisition – A/D and D/A converters, DVM/DMM, quantisation noise in ADCs, selection of ADCs, sample and hold circuit, multiplexer and demultiplexer, programmable gain amplifier, microprocessor interfacing techniques.

TEXT BOOKS:

1. Sende, B.S. – Introduction to System design using Integrated Circuits, New Age International (P), New Delhi.
2. Fitchen, F.C. – Integrated Circuits and Systems, Van Nostrand, New York.
3. Seymous, -Electronic Devices and Components.

COURSE OUTCOME:

Learning this course the students may acquire the following outcomes

1. Sound knowledge in electronic devices and systems
2. Capable to analyse the structure and working of different semiconductor devices
3. Idea about amplifiers and oscillators
4. Knowledge of structure and functioning of filters

(1st Semester)

ELECTIVE-I

BIOMEDICAL INSTRUMENTATION (3-1-0)

Course Objective:

1. To acquire fundamental understanding of anatomy, physiology, and medical terminology appropriate for the role in the health care field.
2. To focus on most of the major fields of activity in which biomedical engineers are engaged.
3. It gives the introductory idea about human physiology system which is very important with respect to design consideration.

MODULE-I

Introduction to the physiology of cardiac, nervous and muscular and respiratory systems, Transducers and Electrodes : Different types of transducers and their selection for Biomedical applications, Electrode theory, Different types of electrode Hydrogen Calomel, Ag-Agcl, Ph, Po2 Pco2 electrodes, selection criteria of electrodes.

MODULE-II

Cardiovascular measurement: The heart and other cardio vascular systems, Measurement of Blood pressure, Blood flow, Cardiac output and cardiac rate, Electrocardiography, Phonocardio-graphy, Ballistocardiography, Plethysmography, Magnet-Cardiography, Cardiac pace-maker, Computer applications.

MODULE-III

Measurement of electrical Activities in Muscles and Brain: Electromyography, Electroencephalograph and their interpretation. Respiratory system measurement: Respiratory mechanism, Measurement of gas volume, flow rate carbon dioxide & oxygen concentration in inhaled air, Respiratory controller. Instrumentation for clinical laboratory: Measurement of pH value of blood. ESR Measurement, Haemoglobin Measurement, oxygen & carbon dioxide concentration in blood, GSR Measurement, Polarographic Measurement, computer application.

MODULE-IV

Medical Imaging: Ultra sound Imaging, Radiography, MRI, Electrical tomography & applications, Biotelemetry : Transmission and reception aspects of biological signals via long distances, Aspects of patient care monitoring.

TEXT BOOKS:

1. Webster J S –Medical instrumentation-Application & Design.
2. Cromwell L–Biomedical instrumentation, PHI

3. Khandpur R S–Hand book on Biomedical instrumentation, TMH, New Delhi1991.
4. Astor B R–Introduction to Biomedical instrumentation & measurement, McMillan.

Course Outcome:

1. There is a vital connection between technology and the care of patients. In many cases, health care workers depend on technology to administer care or treatment or to make a diagnosis. This course helps to understand how technology is tightly woven into patient care.
2. Students will have a clear knowledge about human physiology system
3. Students will gain knowledge of principles, applications and design of the medical instruments most commonly used in the hospital.

(1st Semester)

ELECTIVE-I

INTERNET FOR MEASUREMENT AND CONTROL
(3-1-0)

COURSE OBJECTIVE:

1. To learn the evolution of internet
2. To study about the basic of Network Layer Aspects and Network Security
3. To learn how to take Measurements through Internet
4. To understand the concept of Internet based Control and virtual laboratory

MODULE-I

Introduction to Internet: Origin of Internet – Overview of TCP / IP layers – IP addressing – DNS – Packet switching – Routing – SMTP, POP, MIME, NNTP, ftp, Telnet, HTML, HTTP, URL, SNMP, RFCs, FYIs – STDs, Physical Layer Aspects: Backbone network, Trunks, Routers, Bridges – Access network – MODEMs, WILL, ISDN, XDSL, VSAT.

MODULE-II

Network Layer Aspects and Network Security: IPVG, Mobile IP – IPSEC – IPSO – Public key cryptography – digital signature standard – firewall – Secure socket Layer SSL – Secure Data Network System SDNS – Network layer security Protocol NLSP – Point to point Tunneling Protocol PPTP – SHTTP.

MODULE-III

Measurements through Internet: Web based data acquisition – Monitoring of plant parameters through Internet – Calibration of measuring instruments through Internet.

MODULE-IV

Internet based Control: Virtual laboratory – Web based Control – Tuning of controllers through Internet.

TEXT BOOKS:

1. Douglas E. Camer, Internet working with TCP/IP, Vol. I, Third Edition, Prentice Hall, 1999.
2. Richard Stevens, TCP/IP illustrated, Vol. I, Addison Wesley, 1999.
3. Richard E. Smith, Internet Cryptography, Addison Wesley, 1999.
4. Alessandri Ferrero and Vincenzo Piuri, A simulation Tool for Virtual Laboratory Experiments in WWW environment, IEEE Transactions on IM, Vol. 48, 1999.

5. Kang B. Lee and Richard D. Schneeman, Internet-based Distributed Measurement and Control Application, IEEE magazine IM, June 1999.

COURSE OUTCOME:

Learning this course, the students are able to

1. Understand the basics of internet
2. Work in the field ofNetwork Layer Aspects and Network Security
3. Take Measurements through Internet
4. Know application of virtual laboratory

(1st Semester)

ELECTIVE-I

INSTRUMENTATION FOR ENVIRONMENTAL ANALYSIS (3-1-0)

COURSE OBJECTIVE:

MODULE-I

Electromagnetic radiation, Characteristics, Interaction of e.m. radiation with matter, Spectral methods of analysis, absorption spectroscopy, Beer's law, radiation sources, monochromators and filters, diffraction grating, ultraviolet spectrometer, single beam and double beam instruments.

MODULE-II

Particles emitted in radioactive decay, nuclear radiation detectors, injection chamber, Geiger Muller counter, proportional counter, scintillation counter, Semiconductor detectors.

MODULE-III

Measurement techniques for water quality parameters: conductivity, temperature, turbidity. Measurement techniques for chemical pollutants: chloride, sulphides, nitrates and nitrites, phosphates, fluoride, phenolic compounds.

Measurement techniques for particulate matter in air: Measurement of oxides of sulphur, oxides of nitrogen unburnt hydrocarbons, carbon-monoxide, dust mist and fog.

MODULE-IV

Noise pollution: measurement of sound, tolerable levels of sound, Measurement of sound level, Measurement techniques for soil pollution.

TEXT BOOKS:

1. H.H. Willard, Merrit and Dean, "Instrumental Methods of Analysis", 5th Edn., 1974.
2. R.K. Jain, "Fundamentals of Mechanical and Industrial Instrumentation", 1985.

REFERENCES BOOKS:

1. S.P. Mahajan, "Pollution Control in Process Industries", Tata McGraw Hill, 1985.
2. G. N. Pandey and G.C. Carney, "Environmental Engineering", Tata McGraw-Hill, 1989.

(1st Semester)

INSTRUMENTATION & CONTROL LAB
(0-0-6)

Course Objectives:

1. To give knowledge of working of various sensors & transducers.
2. It gives the knowledge of measuring strain, displacement, temperature, speed, pressure, angular position.
3. Gives the knowledge of Cold junction compensation and linearization thermocouples

EXPERIMENTS:

1. Strain Gauge
2. LVDT
3. Thermistor characteristics
4. RTD- 3 wire and 4 wire
5. IC temperature sensor
6. Capacitive transducer
7. LDR and photo diodes
8. Incremental shaft encoder
9. Cold junction compensation and linearization thermocouples
10. Pressure transducers

Course Outcomes:

Upon completion of this course, students should be able to:
1. Understand the working of various sensors & transducers.
2. Make Cold junction compensation and linearization of thermocouples .
3. Acquire the knowledge of measurement of various parameters .

(2nd Semester)

COMPUTER AIDED DESIGN OF INSTRUMENTATION SYSTEMS (3-1-0)

Course Objectives:

Student will be able to

1. Learn to use computer-assisted/computer-controlled instrumentation and data acquisition systems
2. To provide basic concepts in virtual instruments
3. To know about the programming methods in software used in virtual instrumentation .
4. It provides new concepts towards measurement and automation.
5. To provide a fundamental understanding of common principles, various standards, protocols of the Industrial data communications systems.
6. Learn about finding and calculating errors in measured measurements.

MODULE-I

Data acquisition and instrument interface : Programming and simulation of Building block of instrument Automation system, Signal analysis, I/O port configuration with instrument bus protocols - ADC, DAC, DIO, counters & timers, PC hardware structure, timing, interrupts, DMA, software and hardware installation, current loop, RS 232/RS485, GPIB, USB protocols.

MODULE-II

Virtual instrumentation programming techniques: Block diagram and architecture of a virtual instrument, Graphical programming in data flow, comparison with conventional programming, 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.

MODULE-III

Design test & analysis: Spectral estimation using Fourier Transform, power spectrum, correlation methods, Stability analysis, Fault analysis –Sampling, Data Parity and error coding checks, Synchronization testing, Watch dog timer, DMA method, Real-time Clocking, Noise- Gaussian, White analysis.

MODULE-IV

PC based instrumentation: Introduction, Evolution of signal standard, HART Communication protocol, Communication modes, HART networks, control system interface, HART commands, HART field controller implementation, HART and the OSI model

Simulation of physical systems: Simulation of linear & Non-linear models of systems, Hardware in loop simulation of physical systems using special software.

TEXT BOOKS:

1. K. Ogatta, Modern control Engineering, Fourth edition, Perason education 2002.
2. Dorf and Bishop, Modern Control Engineering, Addison Weseley, 1998.
3. Patrick H. Garrett, High performance Instrumentation and Automation, CRC Press, Taylor & Francis Group, 2005.

Course Outcomes:

On successful completion of this course, it is expected that students should be able to :

1. Use personal computers as instrument controllers and develop simple computer programs to assist in or automate the collection and analysis of experimental data.
2. Ability to understand the basics concepts and programming in virtual instrumentation.
3. Ability to apply virtual instrumentation concept for a given application.
4. Ability to design and ensure the best practice, which is followed in installing and commissioning the data communications links to ensure they run fault-free.

(2nd Semester)

INDUSTRIAL COMMUNICATION SYSTEMS (3-1-0)

COURSE OBJECTIVE:

1. To acquire sound knowledge in network design
2. To get acquainted with different interfaces
3. To gain idea about field buses in industrial applications
4. To study and understand basic of PROFIBUS-PA

MODULE-I

Interface: Introduction, Principles of interface, serial interface and its standards. Parallel interfaces and buses.

MODULE-II

Fieldbus: Use of field buses in industrial plants, functions, international standards, performance, use of Ethernet networks, field bus advantages and disadvantages. Field bus design, installation, economics and documentation.

MODULE-III

Instrumentation network design and upgrade: Instrumentation design goals, cost optimal and accurate sensor networks. Global system architectures, advantages and limitations of open networks, HART network and Foundation fieldbus network.

MODULE-IV

PROFIBUS-PA: Basics, architecture, model, network design and system configuration. Designing PROFIBUS-PA and Foundation Fieldbus segments: general considerations,

TEXT BOOKS:

1. Noltingk B.E., “Instrumentation Reference Book”, 2nd Edition, Butterworth Heinemann, 1995.

2. B.G. Liptak, Process software and digital networks, 3rd Edition, CRC press, Florida.

COURSE OUTCOME:

Learning this course the students will be able to

5. Work in network design field
6. Understand different interfaces
7. Design and implement field buses in industrial applications
8. Understand basic of PROFIBUS-PA

(2nd Semester)

NONLINEAR CONTROL (3-1-0)

Course Objectives:

- To understand the theoretical fundamentals on the control of nonlinear systems
- Ability to apply advanced nonlinear control on a variety of robotics systems
- To Implement control strategy and develop stable system

MODULE-I

Phase plane analysis: Concepts of phase plane analysis- Phase portraits- singular points-Symmetry in phase plane portraits-Constructing Phase Portraits- Phase plane Analysis of Linear and Nonlinear Systems- Existence of Limit Cycles.

Describing function: fundamentals, definitions, assumptions, computing describing functions, common nonlinearities and its describing functions, Nyquist criterion and its extension, existence of limit cycles, stability of limit cycles.

MODULE-II

Lyapunov theory: Nonlinear Systems and Equilibrium Points, Concepts of Stability, Linearization and Local Stability, Lyapunov's Direct Method-Positive definite Functions and Lyapunov Functions, Equilibrium Point Theorems-Invariant Set Theorems-LTI System Analysis based on Lyapunov's Direct Method, Krasovski's Method, Variable Gradient Method, Control Design based on Lyapunov's Direct Method.

MODULE-III

Feedback linearization: Feedback Linearization and the Canonical Form, Mathematical Tools, Input-State, Linearization of SISO Systems, input-Output Linearization of SISO Systems, Generating a Linear Input-Output Relation, Normal Forms, The Zero-Dynamics, Stabilization and Tracking, Inverse Dynamics and Non-Minimum-Phase Systems.

MODULE-IV

Feedback Linearization of MIMO Systems, Zero Dynamics and Control Design. Sliding mode control: Sliding Surfaces, Continuous approximations of Switching Control laws, The Modeling/Performance Trade-Offs-MIMO Systems.

TEXT BOOKS:

1. J A E Slotine and W Li, Applied Nonlinear control, PHI, 1991.
2. Hasan Khalil, Nonlinear systems and control, Prentice Hall.

REFERENCE BOOKS:

1. P.Albertos, A. Sala, Multivariable Control System, Springer, 2004

2. S H Zak, Systems and control, Oxford University Press, 2003.

3. Torkel Glad and Lennart Ljung, Control Theory – Multivariable and Nonlinear Methods, Taylor & Francis, 2002.

4. G. J. Thaler, Automatic control systems, Jaico publishers, 1993.

Course Outcomes:

At the end of the course, the student will be able to

CO1: Students gets knowledge on nonlinear systems.
CO2: Able to apply the concepts of mathematical tools for control of nonlinear systems.
CO3: Able to develop sliding mode controller and stable controller for nonlinear systems.

(2nd Semester)

PROCESS CONTROL AND INSTRUMENTATION (3-1-0)

Course objectives

1. The purpose of this course is to introduce the key concepts in automatic control and instrumentation of process plants.
2. Commonly used sensing, transmission and final control elements are to be described and depicted in piping and Instrumentation Diagrams (P&IDs)
3. The students should be able to characterize and tune simple processes and appreciate the relevance of control systems to safety and profitability.
4. The purpose is to give up-to-date knowledge for designing the process equipment such as heat and mass transfer equipment used in process plants.
5. To gain the knowledge of different process instruments

MODULE-I

Process dynamics: Introduction to process control-objective of modelling-models of industrial process, hydraulic tanks-fluid flow systems-mixing process-chemical reactions-thermal systems heat exchangers and distillation column.

MODULE-II

Control actions and controller tuning: Basic control actions-on/off, P, P+I, P+I+D, floating control, pneumatic and electronic controllers- controller tuning-time response and frequency response methods- non-linear controllers.

MODULE-III

Complex control techniques: Feed forward-ratio-cascade-split range-inferential-predictive-adaptive and multivariable control.
Programmable logic controllers: Evolution of PLC, Sequential and Programmable controllers, Architecture, Programming of PLC, Relay logic and Ladder logic, Functional blocks, Communication Networks for PLC.

MODULE-IV

Computer control of processes: PLC based control of processes, Computer control of liquid level system, heat exchanger, Smart sensors and Field bus.

TEXT BOOKS:

1. George Stephanopolus, Chemical Process Control, Prentice Hall India
2. Harriot P., Process Control, Tata McGraw-Hill, New Delhi, 1991.

REFERENCE BOOKS:

1. Norman A Anderson, Instrumentation for Process Measurement and Control, CRC Press LLC, Florida, 1998.
2. Dale E. Seborg, Thomas F Edgar, Duncan A Mellichamp, Process dynamics and control, Wiley John and Sons, 1989.
3. Marlin T.E., Process Control, Second Edition McGraw hill, New York, 2000.
4. Balchan J.G. and Mumme G., Process Control Structures and Applications, Van Nostrand Renhold Co., New York, 1988.
5. Lucas M.P, Distributed Control System, Van Nostrand Reinhold Co. NY 1986

Course outcomes

1. Understand the basic principles & importance of process control in industrial process plants;
2. Specify the required instrumentation and final elements to ensure that well-tuned control is achieved;
3. The course provides a sound foundation for students wishing to pursue a career in electrical engineering, communications, control systems, robotics or sensor systems through a diverse range of theoretical skills and practical experience of real time applications and design experience
4. Modules of this programme train the students to plan, design, install, operate, control and maintain complex systems that produce, treat and use materials and fuels
5. Use appropriate software tools (e.g. MATLAB Control Toolbox & Simulink) for the modelling of plant dynamics and the design of well-tuned control loops;
6. Knowledge of field instrumentations

(2nd Semester)

ADAPTIVE CONTROL (3-1-0)

Course objectives

1. The purpose of this course is to make understand the students about need and application of system identification of any dynamic systems.
2. The students should be able to apply different parameter estimation methods for identification of systems.
3. The students conceptually clear about different adaptive control techniques and should be able to design adaptive controllers for a given dynamic system.

MODULE-I

System Identification: Introduction, dynamic systems, models, system identification Procedure, Simulation and Prediction, Non-parametric time and frequency domain methods. Linear dynamic system Identification: Overview, excitation signals, general model structure, time series models, models with output feedback, models without output feedback. Convergence and consistency.

MODULE-II

Parameter estimation methods, minimizing prediction errors, linear regressions and Least squares method, Instrumental, variable method, prediction error method. Recursive algorithms. Closed-loop Identification.

MODULE-III

Adaptive Control: Close loop and open loop adaptive control. Self-tuning controller.
Auto tuning for PID controllers: Relay feedback, pattern recognition, correlation technique.

MODULE-IV

Adaptive Smith predictor control: Auto-tuning and self-tuning Smith predictor.
Adaptive advanced control: Pole placement control, minimum variance control, generalized predictive control.

TEXT BOOKS:

1. Ljung .L, System Identification: Theory for the user, Prentice Hall, Englewood Cliffs, 1987.

2. Astrom .K, Adaptive Control, Second Edition, Pearson Education Asia Pte Ltd, 2002.

REFERENCE BOOKS:

1. Chang C. Hong, Tong H. Lee and Weng K. Ho, Adaptive Control, ISA press, Research Triangle Park, 1993.

2. Nelles. O, Nonlinear System Identification, Springer Verlag, Berlin, 2001.

Course outcomes

1. Understand the basic conceptandnecessity of adaptive control in industries.
2. Specify the required instrumentation and final elements to ensure that well-tuned control is achieved;
3. The course provides a sound foundation for students wishing to pursue a career in industries and research area where adaptive controllers are very vital
4. Modules of this programme are to train the students to understand, design and implement appropriate adaptive controllers for a given system
5. The student can identify the dynamics of any given system

(2nd Semester)

ELECTIVE-II

ROBOTICS (3-1-0)

COURSE OBJECTIVE:

1. To make the students understand about the fundamentals of robotic systems

MODULE-I

Basic concepts: Definition and origin of robotics, different types of robots, various generations of robots, degrees of freedom, Asimov's laws of robotics , Dynamic stabilization of robots.

MODULE-II

Power sources and sensors : Hydraulic, pneumatic and electric drives, Determination of HP of motor and gearing ratio, variable speed arrangements, path determination.

MODULE-III

Machine vision, ranging, laser acoustic, magnetic fibre optic and tactile sensors. Manipulators: Construction of manipulators, manipulator dynamic and force control, electronic and pneumatic manipulator control circuits and effectors,.

MODULE-IV

Actuators and Grippers: Various types of Actuators and grippers, design considerations.

TEXT BOOKS:

1. Mair, G.M. –Industrial Robotics, Prentice Hall, NY, 1988.
2. Khafter, R.D., Chimelewski, T.A. and Negin, M. Robot Engineering An Integrated Approach, PHI, New Delhi, 1994.

REFERENCE BOOKS:

1. Braddley, M. et. Al. (Eds) – Robot Motion: Planning and Control, MIT Press, Cambridge, Mass, 1982.
2. Lee, C.S.G. – Robot Arm Kinematics, Dynamics and Control, Computer, IEEE, Vol. 15, No. 12.
3. Paul, R.P. – Robot Manipulators: Mathematics, Programming and Control, MIT Press, Cambridge, Mass, 1981.
4. Mittal and Nagrath,- Robotics and Control, Tata Mc. Graw Hill,.
5. Sponge, M., and Vidyasagar M- Robot Dynamics and Control, John Wiley New York 1989.
6. Craig J.J.- Introduction to Robotics; Mechanisms and Control, 2/e, Addison Wesley, Reading, Mass 1989.

COURSE OUTCOME:

At the end of this course the student should be able to understand

1. The basics of robot
2. End effectors and robot controls
3. Robot Transformations and Sensors
4. Robot cell design and applications
5. Micro/Nano robotic systems

(2nd Semester)

ELECTIVE-II

REMOTE SENSING AND CONTROL (3-1-0)

COURSE OBJECTIVE:

1. To study overview of industrial automation systems.
2. To learn about potential controllers in automation industries.
3. To differentiate between local and remote I/O systems of automation.
4. To study software implementation of Multi-Loop Controllers in Industrial Automation.

MODULE-I

Overview: Structure & components Industrial Automation systems. Architectural levels of Industrial controls. Actuators & sensors: Servomotors, Stepper motors,

MODULE-II

Process I/O systems. Local & remote I/O systems.

MODULE-III

Controllers: Different types of controllers, Single loop and Multiloop controllers and their tunning, Direct controllers and their tunning, Direct controllers and their tunning, Direct controllers and their tunning,

MODULE-IV

Direct Digital Controllers, Software implementation of Multiloop Controllers. Distributed Control Systems.

TEXT BOOKS:

1. George Stephanopolus, Chemical Process Control, Prentice Hall India
2. Harriot P., Process Control, Tata McGraw-Hill, New Delhi, 1991.

REFERENCE BOOKS:

1. Norman A Anderson, Instrumentation for Process Measurement and Control, CRC Press LLC, Florida, 1998.
2. Dale E. Seborg, Thomas F Edgar, Duncan A Mellichamp, Process dynamics and control, Wiley John and Sons, 1989.
3. Marlin T.E., Process Control, Second Edition McGraw hill, New York, 2000.
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5. Lucas M.P, Distributed Control System, Van Nostrand Reinhold Co. NY 1986

COURSE OUTCOME:

After the successful completion of this course, the student will be able to:
1. Select and identify suitable automation hardware for the given application.
2. Analyse and explain potential areas of automation.
3. Differentiate various control aspects of automation.
4. Demonstrate the self-learning capability of Industrial Automation.

(2nd Semester)

ELECTIVE-II

EMBEDED SYSTEM (3-1-0)

COURSE OBJECTIVES

1. To learn C language and assembly programming.
2. To learn Object orientation for programming and C++.
3. To learn software modelling fundamentals.

MODULE-I

Introduction: An embedded system, Processor in the system, Other hardware units, Software embedded into a systems, exemplary system-in-chip, Devices and Device Drivers : I/O devices, Timer and counting devices, serial communication using the IC, CAN and advance I/O buses between the networked multiple devices. Host system or computer parallel communication between the networked I/O multiple devices using the ISA, PCI, PCI-X and advance buses. Device drivers, Parallel port devices drivers in a system, Serial port device drives in a system, Interrupt servicing (Handling) mechanism.

MODULE-II

Software and Programming Concept: Processor selection for an embedded system, memory selection for an embedded system, Embedded programming in C++, Embedded programming in JAVA, Unified modeling language (UML), Multiple processes and application, problem of sharing data by multiple tasks and routines, Inter process communication.

MODULE-III

Real time Operating System: Operating system services, I/O subsystem, Network operating system, Real Time and embedded system, Need of well tested and debugged Real Time operating system (RTOS), Introduction to C/OS-II.Case studies of programming with RTOS: Case study of an embedded system for a smart card.

MODULE-IV

Hardware and Software Co-design: Embedded system project management, Embedded system design and co-design issues in system development process, design cycle in the development phase for an embedded system, Use of software tools for development of an embedded system, Issues in embedded system design.

TEXT BOOKS:

1. Raj Kamal, Embedded System Architecture, Programming and Design, TMH
2. Ralf Niemann, Hardware Software Codesign of Embedded System, Kulwer Academic
3. Sriram V. lyer and Pankaj Gupat, Embedded Real time system Programming, TMH

COURSE OUTCOME

1. Introduce the student with software concepts used in embedded systems.
2. Learning this subject, the students are capable of doing Hardware and Software Co-design
3. The students are get acquainted with the Real Time operating system (RTOS)

(2nd Semester)

PROCESS CONTROL LAB (0-0-6)

COURSE OBJECTIVE

1. To provide basic concepts of processes
2. Students will study and analyze various computer aided calculations-steady state material and energy balances, combustion reactions
3. PLC ladder diagram problems will be solved

LIST OF EXPERIMENTS

1. Designing of Ladder logic for various practical applications, Execution of the Ladders using PLC’s.
2. Study of Analog and Digital Servo Systems.
3. Experiments on Position Control System
4. Velocity Control System
5. Adaptive Control System
6. Non Linear Control Systems.

COURSE OUTCOME

1. Understanding about basic concept, material balance and energy balance for analysisof unit processes and unit operations which is useful for the design the proper controlsystem for process industries.
2. Historical overview of unit operations and unitprocesses, and more recent developments
3. Students can solve control problems with PLC ladder diagram problems