GOVERNMENT COLLEGE OF ENGINEERING, JALGAON [M.S]

(An Autonomous Institute of Government of Maharashtra)

"Globally Accepted Engineers with Human Skills"

Curriculum for
Final Year B. Tech. Instrumentation
2017-18

IN401 DIGITAL IMAGE PROCESSING

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA+15 ISE1+15 ISE2+60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

This course introduces the basic theories and techniques for digital image processing. The course is primarily meant to develop on hand experience in applying these techniques to process images.

Course Objectives:

1. To study the image fundamentals and mathematical transforms necessary for image processing.
2. To study image enhancement, restoration and segmentation techniques.
3. To study image compression procedures.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. understand image formation and the role human visual system plays in perception of gray and color image data.
2. acquire the fundamental as well as advanced concepts of digital image processing.
3. write image processing programs in MATLAB for image processing operations such as histogram equalization, enhancement, filtering etc.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of science, mathematics and electrical/electronics to measurement and control systems.	**3**
d	Apply the concepts of digital, analog electronics, microprocessor system and functionality of system components/devices for the automation of processes.	**2**
f	Use modern engineering tools, software and equipments to design and analyse problems.	**2**
g	Participate and succeed in competitive examinations and engage in life-long learning.	**1**

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

Course Content

Digital Image Fundamentals

Introduction to image processing, digital image representation, pixel, intensity, gray level, brightness, contrast, steps in image processing, elements of DIP system, elements of visual perception, simple image formation model, colour model, sampling and quantization, imaging geometry, 2D linear convolution, 2D circular convolution, 2D correlation.

Image Transforms

Introduction to image transforms and itôs need, classification of image transform, 2D Discrete Fourier Transform and properties, FFT (Decimation in time and Decimation in frequency technique), Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform, Wavelet Transform..

Image Enhancement

Image enhancement by point processing operations- Histogram and histogram equalization, contrast stretching, thresholding, image negative, intensity level slicing, bit extraction, range compression, gamma correction, image arithmetic, Spatial filtering- Low-pass filter, weighted averaging filter, median filter, high-pass filter, Bartlett filter, Gaussian filter, Frequency domain methods- Low-pass and high-pass Butterworth filter, low-pass and high-pass Gaussian filter, homomorphic filter.

Image Restoration and Image Segmentation

Image restoration-degradation model, Linear image restoration techniques, Non-linear image restoration techniques, Blind deconvolution, Image denoising.

Image segmentation- Region approach to image segmentation, clustering techniques, segmentation based on thresholding, edge-based segmentation, edge linking, Watershed transformation.

Image Compression

Need for image compression, types of redundancies, Run length coding, Shannon-Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transform based compression, Image compression standards, Scalar and vector quantization.

Text Books:

1. Digital Image Processing, R. C. Gonzalez and R. E. Woods, Pearson Education, 3rd edition, 2008.
2. Fundamentals of Digital Image Processing, Anil K. Jain, Prentice Hall India, 2010.
3. Digital Image Processing, S. Jayaraman, S. Esakkirajan and T. Veerakumar, McGraw Hill Publication, 2012.

Reference Books:

1. Image Processing, Analysis and Machine Vision, M. Sonka, V. Hlavac and R. Boyle, Thomson Learning, 2nd edition, 2001.
2. Digital Image Processing, Kenneth Castleman, Pearson Education, 2006.

IN402 BIOMEDICAL INSTRUMENTATION

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

This course includes introduction to the Biomedical Instrumentation and Measurement. This course is designed to introduce the students to the basic principles and applications of sensors, medical oscilloscopes, analog and digital instruments. It includes basic knowledge of heart, brain and muscular system, and different types of biomedical signals. Course gives platform to learn the qualitative functions of the four primary system components (sensors, actuators, electronic interface, computational unit)

Course Objectives:

The objective of course are as follows

1. To make understand human anatomy and physiology.
2. To select the appropriate transducer/sensor for biomedical application
2. To make student learn the design and operation of biomedical equipment

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Course Outcomes:

Upon successful completion of this course the students will be able to

1. appreciate structure of human body
2. understand use of Biomedical Instruments
3. selection of Transducers for biomedical instrumentation
4. To evolve an instrumentation system for diagnosis, therapy, supplementation of body functions.
5. Function in interdisciplinary team to solve engineering impact on human pathology.
6. Serve as engineer in medical field for safety of human being.

Relevance of PO's and Strength of Co-relation:

PO. No.	Programme Outcome	strength of co-relation
a	Identify different sensors and transducers required and able to apply them.	**2**
f	Use modern engineering tools, softwares and equipments to design and analyse problems	**1**
k	Excel in Biomedical, Process Instrumentation and virtual Instrumentation.	**3**

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Man Instrument System:

Introduction to gross anatomy of human body , generalised medical measurement system,Problems encountered in measuring a living system,Transducers for biomedical applications ,Cell and its structure, Resting and action potential , Propagation of action potentials ,The heart and cardiovascular system - Electrophysiology of cardiovascular system, Physiology of the respiratory system, Nervous system , Electrode theory ï Biopotential electrodes, Introduction to biomedical instruments, classification and justification

Transducers for biomedical instrumentation:

Types and selection of biomedical transducers, , Cardiological systems, Structure of heart, rhythamicity, cardiac cycle, heart sounds, cardiac output, blood pressure measurement, direct, indirect, Spygmomanometer, Digital B.P.Cardio vascular instrumentation: ECG electrodes, & leads, Cinthoven triangle, ECG quantification, PC based ECG analysis

Instruments for Nervous System

Central Nervous system, the Brain, Receptors, sensory pathway and motor systems, Evoked potential, Electron rephalwogram, EEG analysis, EMG. Mechanics of breathing O2/CO2 transport between lungs and tissue cells, Spirometer, Artificial respiration

Pacemakers, Defibrillators:

Need of pacemaker, types of pacemakers, need of Defibrillator, types of defibrillators, Biotelemetry, bedside monitors, ICU, Heart Lang machine, Phonocardio graph, plethysmograph, Artificial Kidney, Blood cell counters

Biomedical Imaging Techniques

Introduction to Imaging system, X-ray imaging, CT Scan, Ultrasonography, MRI, Endoscopy.

Electrical safety: Significance of electrical danger, Physiological effects of electrical current, Ground shock hazard, and methods of accident prevention

Text Books:

1. Handbook of Biomedical Instrumentation , R S Khandpur, TMH, 2003
2. Cromwell, ñBiomedical Instrumentation and Measurement, PHI

Reference Books:

1. Introduction to Biomedical instrumentation, S G Kahalekar,
2. Handbook of Biomedical Instrumentation, Webster.

IN403 PROJECT PLANNING AND ESTIMATION

Teaching Scheme: 02L Total: 02 **Credits:** 02
Evaluation Scheme: 04 ISA + 08 ISE1 +08 ISE2 + 30 ESE **Total Marks: 50**
Duration of ESE: 2 Hours

Course Description:

This course provides knowledge about various documents required for process plant erection and commissioning. This course provides the knowledge of project, planning, controlling, estimation and economics

Course Objectives:

The objective of the course is to provide students with a firm grasp of the essential principles of project, planning, controlling, estimation and economics.

Course Outcomes

Upon successful completion of this course the students will be able to:

1. apply the knowledge of the documentation for project execution.
2. do the documentation for procurement of instruments/equipment.
3. apply the knowledge for project, planning, controlling, estimation and economics.
4. do higher studies in field of project, planning, controlling, estimation and economic developments

Relevance of PO's and Strength of Co-relation:

PO. No.	Programme Outcome	strength of co-relation
c	Apply concepts of control system and automatic control for the operation continuous and discrete systems.	1
g	Participate and succeed in competitive examinations and engage in life-long learning.	2
j	Follow industrial safety norms and work to benefit environmental and societal context.	2
k	Excel in Biomedical, Process Instrumentation and virtual Instrumentation.	3

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction

Definition of Project; Purpose, scope, time, quantity, and organization structure, Project Life cycle, Project objectives, Project selection, Project formulation and financial Institutions and Government. Process flow sheets, P & I diagrams, Interlock diagrams and Instrument Index Sheets. Instrumentation standards and practices, Legends and Symbols, Instrumentation symbols and Identifications (ANSI/ISA-5.1) Plant layout, General arrangement drawing (Plans and Elevations).

I & C Documentation and Cable Engineering

Specification sheets, loop diagrams, ladder diagrams, wiring diagrams. Isometrics and installation detail drawing, bill of material. Control panel drawing, instrument data sheet. Document control as per ISA standards. Check lists, legend sheets, instrument catalogues, Test and process reports. Different classes of conductors and their routines and NEMA Standards, Types and specifications of cables, cable schedule, routing of cables, types of glands, ferruling and terminations.

Cost Management, PERT and CPM

Cost and Estimation: Types of Estimates, pricing process, salary overheads, labour hours, material and support costs. Network fundamentals, slack time network planning, estimating activity time and total program time. Total PERT and CPM planning, crash times. Software used in project management, software features and classification evaluation and implementation.

Intools Software

Smart Plant Instrumentation, Smart plant electrical, offsite projects, As built/Project Environment, Integration, Modules such as: Instrument index module, Datasheet module, Process data and spec binder, Wiring module, calculation module, loop diagram module, Browser, Instrument specific module, Fieldbus and hook up module, Calibration module and maintainence tools, Users of Intools, Product highlights, External editor, Complementry softwares. Demostration of Intools in Industry ï Case study in Consumer goods, Pharma, Chemical.

Text Books:

1. Applied Instrumentation in Process Industries,Andrew and Williams, Gulf Publishing.
2. Process Control Instruments Engineerôs Handbook, B.G. Liptak, Chilton,2001.
3. Project Management System Approach to Planning Scheduling and Controlling, Hardlod Kerzner, Van Nostrand Reinhold Publishing,5th edition,

Reference Books:

1. Management systems, John Bacon, (ISA).T.G. Fisher,
2. Batch Control Systems, Instrument installation project management,John Bacon, (ISA).
3. Intools software manual,smart plant instrumentation/Intergraph website.
4. Industrial Engineering and Management, O.P. Khanna, DhanpatRai Publication, 4th edition, 1999.

IN404A PLC & DCS

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

The course focuses on programmable logic controller (PLC) & distributed control system (DCS) based industrial Automation systems and Industrial protocol . The course will cover supervisory control system (SCADA), DCS and PLC system in terms of their architecture their interface to the process hardware, the functionality and the application development of the controls of machinery. It gives overview of Industrial management.

Course Objectives:

1. To understand the role of industrial automation for different processes.
2. To learn the application of PLC and DCS based system in process control.
3. To understand the basics of industrial communication protocol.

Course Outcomes:

Upon successful completion of this course the students will be able to

1. apply the knowledge of automation in machine control.
2. design and conduct practical in realistic constrain on motors such that it is applicable in manufacturing, testing and maintenance field.
3. design the automation system for fast and value added quality product for economical growth through technological development.
4. solve engineering solution for fast growing industrial sector with reliable atomized system using PLC and SCADA system.

Relevance of PO's and Strength of Co-relation:

PO. No.	Programme Outcome	strength of co-relation
e	Understand and utilize programmable logic controllers (PLC), distributed control systems (DCS) and supervisory control systems for control of manufacturing and processing systems	3
f	Use modern engineering tools, software and equipments to design and analyze problems.	2
j	Follow industrial safety norms and work to benefit environmental and societal context.	2
c	Apply concepts of control system and automatic control for the operation processes	2
g	Participate and succeed in competitive examinations and engage in life-long learning.	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Industrial Automation Basics

Fundamentals of industrial automation, need and role of automation, evolution of automation, elements of process control loop, current trends, automation strategy evolution, control system audit, automation tools and strategies and their location in plant, introduction to automation tools like PLC, supervisory control and data acquisition (SCADA), distributed control system (DCS), hybrid DCS/PLC.

Programmable Logic Controller

Evolution of PLC, definition, functions, advantages, architecture, DI-DO-AI-AO examples and ratings, I/O module, working of PLC, scan time, types of PLC, choosing PLC for application, installation of PLC, rack installation, grounding and shielding, physical, electrical, maintenance requirements, planning, verifying, troubleshooting, fault diagnosis techniques, Need of interfacing, PLC interface to hydraulic/pneumatic circuits, solid-state device, development of relay logic ladder diagram, introduction to PLC programming, programming devices and languages as per IEC 61131-3 like IL, ST, FBD, CFC, SFC, PLC timers and counters, PLC selection, installation and troubleshooting, advanced PLC instructions like program control, comparison, mathematical, logical, communication, shift registers, sequencers, data handling, advanced mathematical, PLC programming for industrial applications using advanced instructions.

Distributed Control System

DCS ï basic packages introduction, analog control, direct digital control, distributed process control, DCS configuration with associated accessories, control console equipment, control unit (relay rack mounted equipments), local control units, and attributes of DCS & DCS flow sheet symbols, DCS system integration, I/O hardware stations, set-point station control, supervisory computer tasks & configurations, system integration with PLCs and computers, human machine interface for process monitoring and control, introduction to expert systems, and statistical process controls.

Industrial Protocol and Communications

Introduction, Evolution of signal standard, HART protocol, HART Commands and Networks, HART Applications, Field bus: Introduction, architecture, advantages and limitations of field bus, Basic requirements of Fieldbus standard, Fieldbus topology, Interoperability and Interchangeability. Profibus:- Introduction, Profibus protocol stack, Profibus communication model, Communication objects, System operation and Troubleshooting ï Foundation fieldbus versus Profibus. Introduction of device net, control net, CAN, industrial Ethernet, MAP and TOP.

Data Acquisition and System Interfacing

Programming and simulation of Building block of instrument Automation system, Signal analysis, I/O port configuration with instrument bus protocols, ADC, DAC, AO/AI, DIO,

counters & timers, PC hardware structure, timing, interrupts, DMA, software and hardware installation, current loop, RS 232/RS485, GPIB, USB protocols.

Applications of Automation Tools

Automation application of the PLC/DCS/SCADA-DAQ for controlling units (parameters and elements) in Cement plant, thermal power plant, power plant, steel plant, glass manufacturing plant, paper and pulp plant, Sugar plant, chemical and petrochemical plants.

Text Books

1. Instruments Engineers Handbook,VoL-II, Process Control, Bela G. Liptak, Chilton, 3rd edition,.1995
2. Programmable Logic Controller,J.D.Otter, (PHI),1st edition, 1987.
3. Industrial Engineering and Management,O.P. Khanna, DhanpatRai Publication, 4th edition, 1999.

Reference Books

1. Application of Computer in Process Control ,Considine, Tata McGraw Hill,5thedition, 2009.
2. Modern Control Techniques for the process industries, T.H Tsai, J.W Lane, Mareet Dekkar, 1st edition, N.Y 1986
3. Distributed Computer Control for Industrial Automation, Vijay P. Bhatkar, Dobrivoje Popovic, Dekker,CRC Press ,2 nd edition, 1990.
4. Computer-based Industrial Controls , Krishan Kant, PHI ,2nd edition, 2004.

IN404B VIRTUAL INSTRUMENTATION

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

This course gives opportunity to learn basics of Graphical and Dataflow programming. Understanding of NI LabVIEW Software. Use various tools in software for developing Virtual instruments. Study of different hardware for interfacing real data signal to LabVIEW. Study of designing of applications for real time systems in Measurement, Control, Biomedical and Automation.

Course Objectives:

1. Define new concepts in measurement, control and Automation.
2. Understand concept of Graphical programming using LabVIEW.
3. Study of design of Virtual Instruments using LabVIEW.
4. Acquire knowledge on how virtual instrumentation can be applied for data acquisition and instrument control.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Use of various tools in software for developing a VI and interfacing different Hardware.
2. Identify salient traits of a virtual instrument and incorporate these traits in their Projects.
3. Apply knowledge for developing projects in the area of Biomedical, Aerospace, Measurement and Control.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of Science, mathematics and electrical / electronics to measurement and control systems.	1
d	Apply the concepts of digital, analog electronics, microprocessor systems and functionality of system components/devices for the automation of processes.	2
f	Use modern engineering tools, software and equipments to design and analyze problems.	2
I	An ability to work professionally in both software and hardware system areas including the design and realization of such systems	3

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Virtual Instrumentation

Review of Virtual Instrumentation(VI), Historical perspective, Need of VI, Advantages of VI, Define VI, block diagram and architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming.

Graphical Programming using LabVIEW

Programming Techniques, VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string, file handling, stes machines etc.

Hardware

Data Acquisition basics, ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation.

Common Instrument Interfaces for Current loop, Rs 232C/Rs 485, GPIB, System basics, interface basics: USB, PCMCIA, VXI, SCXI, PXI VISA & IVI, hardware for image acquisition and processing, Motion Control.

Applications

Use of Analysis Tools, Fourier transforms windowing & flittering. Application of VI: Application in Process Control Designing of equipments like Oscilloscope, Digital Millimeter using Lab view Software, Study of Virtual instrumentation for data acquisition and control using Lab VIEW for Physical parameters like temperature, pressure, flow, level etc. Design of automation systems using tools of image acquisition and processing using LabVIEW.

Text Books:

1. Labview Graphical Programming, Gary Johnson, MC GrawHill, Newyork, 2 nd edition, 1997
2. Labview for everyone ,Lisa K. Wells & Jettrey Travis, Prentice Hall, New Jersey, 1997.

Reference Books:

1. Basic Concepts of Labview ,Sokoloff, Prentice Hall, New Jercy, 1998.
2. PC interfacing for Data Acquisition & process control , S. Gupta, J.P.Gupta, Instrument Society of America, 2 ndEdition, 1994.

IN405A INDUSTRIAL DRIVES AND CONTROL

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

This Course explores the knowledge of different industrial derives and their controls, load characteristic, factor effecting on selection of drives depending upon their electrical, mechanical characteristic. The subject also provides the knowledge of microprocessor based electric drives and study of modern electric drives.

Prerequisite: Knowledge of Electrical Machines and Power Electronics.

Course Objectives:

1. Introduction to different types of drives and applications in various industries.
2. To know the characteristics of various motors and loads.
3. Gain the knowledge about operation of DC motor speed control using converters and choppers.
4. To enable the students, identify the need and choice for various drives.

Course Outcome:

After completion of course students will be able to:

1. Understand different speed control methods in D.C and A.C motors using closed loop control schemes.
2. Understand the characteristic of load and selection of derive in industrial sectors.
3. Discharge professional duties in industries with innovative ideas of operation and control of drives.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	An ability to apply knowledge of mathematics, science, and engineering.	2
e	An ability to identify, formulates, and solves engineering problems	3
f	Use modern engineering tools, software and equipments to design and analyze problems.	1
l	An ability to work professionally in both software and hardware system areas including the design and realization of such systems	2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to motor drives

Drives: Classification, comparison of AC and DC drives, Basic elements, torque equations, component of load torque, multi-quadrant operation, equivalent drive parameters, components of power electronic drives criteria for selection of drive components match between the motor and the load, match between the motor and power electronics converter

DC drives

DC drives System model, motor rating, motor mechanism dynamics, drive transfer function, effect of armature current waveform, torque pulsations, adjustable speed drives, chopper fed and 1 phase converter fed drives, effect of field weakening.

AC Drives

Induction Motor drives Basic Principle of operation, stator voltage control of induction motor, torque-slip characteristics, operation with different types of load, speed control by varying stator frequency and voltage.

Synchronous motor drives: Review of synchronous motor fundamental, speed control of synchronous motors, adjustable frequency operation of synchronous motors, principles of synchronous motor control.

Special Drives

Stepper Motors: Constructional features, principle of operation, modes of excitation, single phase stepping motors, applications.

Switched Reluctance Motors: Constructional features, principle of operation. Torque equation, Power controllers, Characteristics and control, applications.

Permanent Magnet Brushless DC Motors: Commutation in DC motors, Difference between mechanical and electronic commutators, Torque and emf equation, Torque-speed characteristics, applications.

Closed loop control of drives

Voltage and current control methods, closed loop control design for ac and dc drives using motor transfer function.

Text Books:

1. Electric Machines and Drives, Ned Mohan, Wiley India Pvt. Ltd., 2013
2. Modern Power Electronics & AC drives ,B K Bose, Pearson, 2002.

Reference Books:

1. Power Electronics Circuit Devices & Applications ,M. Rashid, Prentice Hall of India.
2. Fundamentals of Electrical Drive, G. K. Dubey, Narosa Publishing House.
3. Electric Machines and Drives, Ned Mohan, Wiley India Pvt. Ltd.
4. Switched Reluctance Motor and Their Control, Miller T J E Clarendon Press, Oxford, 1993.
5. Brushless Permanent Magnet and Reluctance Motor Drives, Miller T J E, Clarendon Press, Oxford, 1989.
6. Stepping Motors and Their Microprocessor Control , Kenjo T, Sugawara A, Clarendon Press, Oxford, 1994

IN405B ENVIRONMENTAL INSTRUMENTATION

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

This course exposes the student to a variety of analytical techniques and instruments utilized in environmental chemical analysis. It is designed to couple theory of equipment operation with a basic understanding of the chemical principles involved.

Course Objectives:

1. To introduce the instrumentation methodologies for environment monitoring.
2. To deal with water quality monitoring and waste water treatment
3. To discuss the instrumentation required for air pollution monitoring

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. design instrumentation systems for environment monitoring.
2. develop algorithms for waste water treatment
3. measure and analyse air quality and other parameters.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of Science, mathematics and electrical / electronics to measurement and control systems.	1
j	Follow industrial safety norms and work to benefit environmental and societal context.	2
f	Use modern engineering tools, software and equipmentôs to design and analyse problems.	1
i	Identify different sensors and transducers required and able to apply them.	3

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction

Necessity of instrumentation & control for environment, Importance of environmental Instrumentation sensor requirement for environment. Instrumentation methodologies: Ultraviolet analyzers, total hydrocarbon analyzers using flame ionization detector, Gas chromatography in environmental analysis, photo ionization, portable & stationary analytical instruments.

Quality of water

Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters: Thermal conductivity, detectors, Opacity monitors, pH analyzers & their application, conductivity analyzers & their application. Water treatment: Requirement of water treatment facilities, process design.

Sedimentation & flotation

General equation for settling or rising of discrete particles, hindered settling, effect of temperature, viscosity, efficiency of an ideal settling basin, reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation. Ground water monitoring: Level measurement in ground water monitoring wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution.

Waste water and Flow monitoring system

Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants.

Flow monitoring: Non-open channel flow measurement, open channel waste water flow measurement. Rain water harvesting: necessity, methods, role of NGOs & municipal corporation.

Air Pollution and Sound Monitoring Systems

Definitions, energy environment relationship, importance of air pollution, Air sampling methods & equipments, analytical methods for air pollution studies. Control of air pollution. Sound pollution: basics of sound pollution, its effect to environment. Acoustic noise measurement & monitoring.

Instruments in Weather station

Instruments in Weather station like Barometer, Rain gauge, Ceilometer etc. Global environmental analysis, Virtual Instruments in Environmental Engineering Laboratory, Rover Environmental Monitoring station (REMS).

Text Books:

1. Environmental Engineering and Science, Gilber M Masters, Pearson Education ,1997
2. Environmental Instrumentation & Analysis Handbook, Randy D. Down & Jay H. Lehr, Wiley.
3. Environmental Engineering, Peany Howard S, Donal R Rowe and George Tacho Banoylous Teddy.
4. Air pollution control technology, Wark & Warner.

Reference books:

1. Air pollution engineering, M. N. Rao & H. V. N. Rao
2. Environmental noise pollution, Patrick F. Cunniff, Wiley, May-1977.
3. Water treatment technology,Walter J. Weber.

IN405C OPTICAL INSTRUMENTATION

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

Basic concepts of optical fibers and their properties. Fiber Optic based measurement Systems. Lasers and their uses in different industrial purposes.

Course Objectives:

To introduce the basic concepts of optical fibers and Lasers and their applications in the field of instrumentation.

Course Outcomes:

Upon the completion of this course students will be able to,

1. obtain the knowledge needed to perform fiber-optic communication system engineering calculation.
2. apply knowledge to modern fiber-optic systems.
3. evaluate real time systems
4. understand the most recent literature in the field of fiber-optic communications.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of Science, mathematics and electrical / electronics to measurement and control systems.	2
b	Identify different sensors and transducers required and able to apply them.	3
f	Use modern engineering tools, softwares and equipments to design and analyse problems.	1
h	Communicate effectively and work in multidisciplinary teams.	2
j	Follow industrial safety norms and work to benefit environmental and societal context.	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction

Principle of light propagations through a fiber, different types of fibers and their properties. Fiber material and their characteristics- transmission characteristics of fibers, absorption losses, scattering losses, dispersion, measurement on optical fibers, optical sources and detectors,LEDôs.

Measurement Techniques

Fiber optic instrumentation system, fiber optic sensors, different types of modulators. Application in instrumentation- Interferometric method of measurement, measurement of temperature, pressure, current, voltage, liquid level and strain. OTDR and its applications. Analog and digital communication link, Optical power budget.

Laser fundamentals and types

Fundamental characteristics of Laser, three level and four level lasers, properties of laser, laser modes, optical resonator, Q switching, cavity dumping, mode locking, types of laser, Gas laser, solid laser, liquid laser, semiconductor laser.

Laser Applications

Laser for measurement of current, voltage and atmospheric effects, spatial frequency filtering. Holography- basic principle, methods, holographic interferometry, Holography for non destructive testing, Holographic components. Applications in material processing. Laser drilling, laser cutting, laser tracking, medical applications of laser, laser and tissue interaction, laser instrumentation for surgery.

Text Books:

1. Optial fiber communications ,John M. Senior, Pearson Publications, 2 nd edition,.
2. Optical fiber communications , Gerd Keiser, Tata McGraw Hill Pub ,4 th edition,.

Reference Books:

1. Fiber Optic Communication- Systems and Components ,Vivekanand Mishra and Sunita P. Ugale, Wiley-India Pub.
2. Laser Systems and Applications ,Nityanand Chudhary and Richa Verma, PHI Learning Pvt. Ltd.

IN405D SOFT COMPUTING

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

This course introduces the advance concepts of soft computing which required in controllers design and optimization purposes. The course is primarily meant to develop on smart experience in applying these techniques to process control problem.

Course Objectives

1. To expose the concepts of feed forward neural networks.
2. To provide adequate knowledge about feedback neural networks.
3. To teach about the concept of fuzziness involved in various systems.
4. To expose the ideas about genetic algorithm
5. To provide adequate knowledge about of FLC and NN toolbox

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. understand formation and the role soft computing methodologies in process control and instrumentation.
2. acquire the fundamental as well as advanced concepts of Soft Computing Tools.
3. develop algorithms in software and use of it for real time process control.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of science, mathematics and soft computing for process control problem	**3**
d	Apply the concepts of optimization tools for various applications in process industry.	**1**
f	Use modern engineering tools, software and equipments to design and analyse problems.	**2**
g	Participate and succeed in global industry and engage in life-long learning in process systems.	**2**

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction of Soft Computing

Introduction : Natural language processing , Machine Learning and Neural Networks, Fuzzy Systems, Pattern Recognition and Text Processing, Intelligent systems and their applications , Intelligent interfaces. Swarm Intelligence ,Genetic Algorithm . Robotics and Kinematics . soft computing vs. hard computing; various types of soft computing techniques; applications of soft computing

Neural network model and algorithms

Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture, single layer and multilayer feed forward networks, Mc Culloch Pitts neuron model, perceptron model, Adaline and Madaline, multilayer perception model, back propogation learning methods, effect of learning rule coefficient, back propagation algorithm, factors affecting back propagation training, applications.

Advances in Neural Networks

Introduction of back propagation learning methods and algorithm, Counter propagation network-architecture, functioning & characteristics of counter Propagation Network-Hopfield/ Recurrent network-configuration, stability constraints associative memory and characteristics- limitations and applications, Hopfield v/s Boltzman machine, Adaptive Resonance Theory, Architecture- classifications Implementation and training, Associative Memory.

Fuzzy Logic Modeling and Control

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.

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.

Applications of Soft Computing

Application to control system optimization 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. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Laurene V. Fausett, Pearson Education,

2. Fuzzy Logic with Engineering Applications, Timothy J. Ross, Wiley India.

3.Genetic Algorithms in Search, Optimization, and Machine Learning, David E.Goldberg, Pearson Education, 2009.

Reference Books:

1. Fuzzy set theory and its Applications, Zimmermann H.J, Springer international edition, 2011.
2. Neural Networks for Control, W. T. Miller, R.S.Sutton and P.J.Webrose, MIT Press, 1996.

IN 406 DIGITAL IMAGE PROCESSING LAB

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

Course Description:

This course covers various aspects of image processing techniques and tools. Examples and programs will be covered to clarify the concepts and provide students an opportunity to learn by doing. This course makes extensive use of MATLAB/LabVIEW/SCILAB by which the design and implementation of image processing operations can be explored.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN401.
The list given below is just a guideline.

1. Introduction to IP toolbox.
2. Perform arithmetic and logical operations on image.
3. Application of colour image processing like extraction of colour components and
4. Application of FFT to perform operations on image like convolution, translation.
5. Application of FFT to perform operations on image like rotation.
6. Generation of Walsh basis for given order.
7. Application of Histogram Equalization of grey level image and colour image.
8. Application of gray level transformation like image negative, thresholding, gray-level slicing, logarithmic transformation, exponential transformation and power law transformation.
9. Application of linear image restoration techniques like inverse filtering, Pseudo-Inverse filtering and Wiener filtering.
10. Application of Edge detection.
11. Application of Filtering by applying LPF and mask for smoothening of image.
12. Application of Filtering by applying HPF and mask for sharpening of image.

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN407 BIOMEDICAL INSTRUMENTATION LAB

Teaching Scheme: 02P Total: 02 **Credit:** 01

Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50

Duration of ESE: 03Hrs

Course Description:

This course is designed to introduce the basic principles and applications of biomedical sensor. It also includes the study of different biomedical instruments used for recording and analyzing the monitoring signal generated by different physiological systems of Human.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN407. The list given below is just a guideline.

1. Measurement of Biomedical Parameters.
2. Measurement of cardiovascular parameters
3. ECG Analysis.
4. EEG Analysis.
5. EMG Analysis.
6. Measurement of blood sugar.
7. Measurement of heartbeats using heart beat monitor.
8. Measurement of lung capacity using spirometer.
9. Demonstration of defibrillator.
10. Demonstration of different imaging modalities
11. Measurement of blood pressure by indirect method.
12. Electrical safety measures in hospitals.

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN408A INDUSTRIAL DRIVES AND CONTROL LAB

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

Course Description:

In this laboratory, course emphasis will be on understanding construction, working, characteristics and speed control methodologies for various AC and DC drives.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN405A. The list given below is just a guideline.

Note: Following experiments shall be performed using laboratory setup available and using matlab/simulink/SciLab/LabView etc.

List of Experiment:

1. Determine speed torque characteristics of DC motor.
2. Test performance of speed control of DC motor using choppers.
3. Closed loop control of DC motor.
4. Speed Control of DC Shunt motor using Chopper.
5. Speed Control of Single Phase Induction motor using ac voltage regulator.
6. Design a closed loop control of single phase AC motor using PI/PID control.
7. Speed Control of Three Phase Induction motor using ac voltage regulator.
8. Speed Control of Stepper motor.
9. Design PC/PLC based Speed control of Stepper motor.
10. Performance and characteristics of Switched reluctance motor.
11. Design a closed loop control of Switched reluctance motor using PI/PID control
12. Performance and characteristics of Permanent Magnet Brushless DC Motor.

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN408B ENVIRONMENTAL INSTRUMENTATION LAB

Teaching Scheme: 02P Total: 02 **Credit: 01**
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks: 50**
Duration of ESE: 03Hrs

Course Description:
This course exposes the student to a variety of analytical techniques and instruments utilized in environmental chemical analysis. It is designed to couple theory of equipment operation with a basic understanding of the chemical principles involved.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN405B. The list given below is just a guideline.

1. Measurement of pH for given liquid
2. To analyse gas sample by thermal conductivity method.
3. To measure Co2 in a given sample by Co2 analyser
4. To measure conductivity of a given solution by conductivity meter
5. To measure total dissolved O2 in water
6. To study spectra photometer
7. Analysis of gas-by-gas chromatograph
8. Demonstration of infrared Analyser
9. Demonstration of Mass spectrograph
10. Measurement of light intensity by lux meter.
11. Measurement of radiation by infrared meter.
12. Analysis of optical filter.
13. Determination of turbidity from water sample using Nephelo turbidity meter.
14. Determination of flouride concentration in drinking water using spectrophotometer.
15. Colorimetric analysis for copper using UV-Vis spectrophotometer.
16. Preparation of calibration curve of chromium using UV- Vis spectrophotometer.
17. Determination of metals (chromium/nickel/copper/arsenic) using Atomic Absorption Spectrophotometer.
18. Determination of cations and anions using Ion-Chromatograph
19. Determination of TOC from wastewater using TOC analyzer

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN408C FIBER OPTICS AND LASER INSTRUMENTATION LAB

Teaching Scheme: 02P Total: 02 **Credit: 01**
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks: 50**
Duration of ESE: 03Hrs

Course Description:

In this laboratory course emphasis will be on propagation characteristics of optical fiber. Different measurement techniques, data analysis and fault detections.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN405C. The list given below is just a guideline.

1. To study attenuation losses in optical fiber.
2. To study bending losses in optical fiber.
3. Measurement of numerical aperture of an optical fiber.
4. Study of analog fiber optic communication link.
5. Study of digital fiber optic communication link.
6. To study characteristic curve for optical source and detector.
7. Study of Nd-Yag Laser.
8. Study of OTDR and measurement techniques on OTDR.
9. Study of analog modulation technique.
10. Study of digital modulation technique.

Guideline for ICA:

ICA shall be based on continuous evaluation of student performance throughout the semester and practical assignment submitted by the student in the form of journal.

Guideline for ESE:

In ESE the student may be asked questions on practical. Evaluation will be based on answers given by students in oral examination.

IN408D SOFT COMPUTING LAB

Teaching Scheme: 02P Total: 02 **Credit: 01**
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks: 50**
Duration of ESE: 03Hrs

Course Description:
This course exposes the student to a variety of soft computingl techniques and its utilized in process control analysis and design. It is designed to couple theory and practicals of soft tools with a basic understanding of the algorithms and its implementation

Course Objectives

1. To expose the concepts of feed forward neural networks.
2. To provide adequate knowledge about feed back neural networks.
3. To teach about the concept of fuzziness involved in various systems.
4. To expose the ideas about genetic algorithm
5. To provide adequate knowledge about of FLC and NN toolbox

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. understand formation and the role soft computing methodologies in process control and Instrumentation.
2. Acquire the fundamental as well as advanced concepts of Soft Computing Tools.
3. Develop algorithms in software and use of it for real time process control.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN405D. The list given below is just a guideline.

1. Develop logic of square and multiplication of squares using Neural Network(NN)
2. Develop logic of square and multiplication of squares using Fuzzy Logic(FL)
3. Develop logic of square and multiplication of squares using GA
4. Develop Mc Culloch Pitts neuron model using soft tool and verify the results
5. Develop back propagation algorithm of neural network
6. Develop algorithm using neural network for control of system(e.g. level)
7. Develop algorithm of modelling using Fuzzy Systems
8. Develop Control algorithm using fuzzy system
9. Develop optimization algorithm using fuzzy system for given first/second order system
10. Develop control schemes for nonlinear systems using NN or FL or GA
11. Develop PID or any other control algorithm using Fuzzy Logic for any second order systems
12. Develop PID or any other control algorithm using NN for any second order systems
13. Develop PID or any other control algorithm using GA for any second order systems
14. Study of application of control system optimizations: Case study
15. Identification of linear systems using any soft computing method
16. Stability analysis of the system using any soft computing tools

Note:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**
- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

IN409 PROJECT PHASE-I

Teaching Scheme: 04Hrs/week **Credit:** 02
Evaluation scheme: 50 ICA+ 50 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

The project is one of the most important work in the degree programmer. It is introduced in curriculum to put into practice some of the techniques that have been taught to students in earlier years. It also provides the opportunity to students to demonstrate independence and originality, to plan and organize a large project over a long period. The project topic should be selected to ensure the satisfaction of the need to establish a direct link between the techniques they learnt and productivity. Thus it should reduce the gap between the world of work and the world of study.

Desirable Awareness/Skills:

Knowledge of concepts, principles and techniques studied in all earlier courses.

Course Objectives:

The objectives of offering this course are:

1. to develop ability to synthesize knowledge and skills previously gained and to put some of them into practice.
2. to make students capable to select from different methodologies, methods and forms of analysis studied to produce a suitable system or sub-system.
3. to inculcate ability to present the findings of their technical solution in a written report.
4. to plan and organize a large project over a long period.

Course outcome:

On successful completion of this course students shall be

1. able to apply the knowledge and skills previously gained into practice.
2. take appropriate decision wrt various parameters related to production of a system or sub- system.
3. demonstrate the leadership quality along with ability to work in a group.
4. prove the ability to present the findings in a written report or oral presentation.

Relevance of PO's and Strength of Co-relation:

Sr No	PO	Level of co-relation
c	Apply concepts of control system and automatic control for the operation of continuous and discrete systems.	**2**
e	Understand and utilize programmable logic controllers (PLC), distributed control systems (DCS) and supervisory control systems for control of manufacturing and processing systems.	**2**
f	Use modern engineering tools, softwares and equipments to design and analyze problems.	**1**
j	Follow industrial safety norms and work to benefit environmental and societal context.	**1**

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

Course Content

- The project shall be carried out in-house i.e. in the departmentôs laboratories/centres by a group 2 ï 4 students. In any case the group shall not consist of more than four students.

- The project shall consist of design and implementation of any suitable instrumentation application system, sub system or software based on knowledge and skills previously gained.

- The project outline (synopsis) on the selected topic should be submitted to the course coordinator for approval within one week from the commencement of the term.

- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation.

Project Deliverables: A project report as per the specified format (available on in the department and institutes website), developed system in the form of hardware and/or software. In addition, student shall maintain a record of attendance and continuous progress (log book in appropriate format available on institute/departmentôs web site) duly signed by course coordinator and present as mini project phase deliverable along with report.

Evaluation System:

It includes Internal Continuous Assessment (ICA) and End Semester Examination (ESE).
Guidelines for ICA and ESE are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated twice in the semester. A committee comprising of three examiners (one of them should be guide) nominated by head of department, will take the review of the project work twice in a semester. Committee shall judge the students on the principle of continuous evaluation and contribution of individual student in the group. Average of two reviews shall be considered as overall performance of the student
- It shall be evaluated on the basis of deliverables of project and depth of understanding.
- Course coordinator shall maintain the record of continuous evaluation in appropriate format available on institute/departmentôs web site.

End Semester Examination (ESE)

The End Semester Examination for this course shall be based on demonstration of the system or sub system developed by the group of students, deliverables of project and depth of understanding (oral examination). It shall be evaluated by two examiners out of which one examiner shall be out of institute. The ESE of Industry sponsored project may be conducted at site if needed.

IN410 SEMINAR

Teaching Scheme: 02PR Total: 02 **Credits:** 02
Evaluation Scheme: 50 ICA **Total Marks:** 50

Course Description:

This course explores the knowledge of presentation and communication. Also, it develops ability to work on identify, formulate and solve engineering problems in view of economic, environmental and social aspect.

Course Objectives:

1. To develop the ability to express our views and improve presentation skills.
2. To study various international, national journals to identify, understand and formulate the problem.
3. To apply effective strategies in literature searches

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. understand literature survey for selection of seminar topics.
2. apply knowledge of mathematics, science and engineering for effective presentation.
3. identify, formulate and solve engineering problems by understanding professional as well as ethical responsibility.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of science, mathematics and electrical/ electronics to measurement and control systems.	**3**
f	Use modern engineering tools, softwares and equipment to design and analyse problems.	**2**
g	Participate and succeed in competitive examinations and engage in life-long learning.	**1**
h	Communicate effectively and work in multidisciplinary teams.	**2**

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

1. Each student shall select a topic for seminar which is not covered in curriculum. Seminar topic should not be repeated and registration of the same shall be done on first come first serve basis.
2. Topic of seminar shall be registered within a three weeks from commencement of VII semester and shall be approved by the committee.
3. The three member committee appointed by Head of Department shall be constituted for finalizing the topics of seminar. Seminar shall be related state of the art topic of his/her choice approved by the committee.
4. Each student should deliver a seminar in a scheduled period (Specified in time framed by the department) and submit the seminar report (spiral bound).

Guidelines for ICA: Assessment of the seminar for award of ICA marks shall be done jointly by the guide and a departmental committee, as per the evaluation parameters given in **Table-I**

Table-I

Sr. No.	Name of Student	Seminar Topic	Topic Selection	Literature Survey	Delivery of the Seminar	Contents of the Seminar	Depth of Understa-nding	Report Writing	Total
			10	10	10	05	05	10	50

IN451 INSTRUMENTATION SYSTEM DESIGN

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

The course provides an overview of static and dynamic performance characteristics of instruments. Selection criteria for flow, temperature transducers. Design considerations for transducers such as thermocouple, RTD, orifice plates, Rota meter. Calibration and installation procedure for different transducers

Course Objectives:

The objectives of this course are

1. To understand the signal conditioning of different transducers.
2. To learn the reliability concepts

Course Outcomes:

Upon successful completion of this course the students will be able to

1. Understand Signal Conditioning for Transducers.
2. calculate the reliability of the n system

Relevance of PO's and Strength of Co-relation:

PO. No.	Programme Outcome	strength of co-relation
b	Identify different sensors and transducers required and able to apply them.	**3**
d	Apply the concepts of digital, analog electronics, microprocessor systems and functionality of system components/devices for the automation of processes	**2**
f	Use modern engineering tools, softwares and equipments to design and analyse problems	**1**
k	Excel in Biomedical, Process Instrumentation and virtual Instrumentation.	**1**

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course content

Basic Concepts of Transducer Design:

General transducer design consideration, testing of transducer, and selection criteria of transducer. Design of temperature measurement system based on RTD, Thermocouple and thermistors, Design of Displacement measurement system based using LVDT, Potentiometer, Ultrasonic transducer, Complete signal conditioning circuits for above temperature and Displacement transducers.

Design aspects of flow & Pressure transducers:

Design of orifice, rotameter, venture based flow system and signal conditioning circuits for above system. Design of level sensors and its signal conditioning circuits, design of pressure gauge, diaphragm based pressure gauge, Load cell and its signal conditioning, study of P/I and I/P converters, Design of smart transmitters

Reliability:

Concept of reliability definition, Distinction between Quality and reliability, failures, Availability, Maintainability, (MTBF, MTTF, MTTR) Life Cycle and Bathtub curve, Reliability Modeling Exponential, Weibull and Gamma Distribution, Hazard rate and Derivation of MTTF Failure Density Function, Cumulative Distribution Function and Reliability, availability, maintainability, quality assurance.

Noise Free Design:

Guidelines for enclosure: components and accessories, Grounding and shielding techniques noise in electronic circuits, EMI/ EMC protection against EMI, ESD selection of cables, connectors, types of knobs, mechanical fixture PCB holders, clamps, control panel layout ergonomics, types of' gear boxes and drives. Ingress protection authorized regulatory bodies for certifying instruments in Hazardous location (BASEEFA, FM, PTB, UL, CESI, LLIE, CSA, DEMKO, IEC&CENELEC).

Design of control panels & controllers:

Control Panel Design: Design considerations, Type of control panel designs, Ergonomics in design of control, control room layout, cabling, wiring details. Pneumatic controllers using flapper-nozzle mechanism, Electronics controller using op-amps, considerations in design of data presentation elements, recorders, and monitors.

Text Books:

1. Measurement Systems, Doeblin E. O. and D. Mannik, 5th Edition,
2. Application and Design, McGraw Hill International Edition, 2006.
3. Process Control Instrumentation Technology, Johnson C. D, Pearson Education, New Delhi, 7th Edition, 2003.
4. Reliability Engineering, E. Balguruswamy, PHI.

Reference Books:

1. Electrostatic Discharge and Electronic Equipment, Warren Boxleitner, IEEEpresse.
2. Applications of Analog Intergrated Circuit, S. Soclof, PHI.
3. Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II, Liptak B. G, Chilton Book Company, 2001
4. A Course in Mechanical Measurements and Instrumentation, Sawhney A. K. and Puneet Sawhney, Dhanpat Rai and Co. (P) Ltd, New Delhi, 1998.
5. Applied Instrumentation in the Process Industries Vol. I and Vol. II, Andrew Williams, GWF Publishing Company

IN452 PROCESS INSTRUMENTATION

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

The course focuses on Process Instrumentation. The course will cover process characteristics, Multiloop control, Different process control loop analysis tuning of PID Controller for different process and their response for change in load and set point. It gives overview of process control design.

Course Objectives:

1. To understand the Design aspects of process and control system for typical pilot plant and processes.
2. To learn Design advance controllerôs strategies
3. To integrate various process loop components

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. apply the principles and practices for Process control
2. apply various control techniques to processes
3. design multivariable control scheme.

Relevance of PO's and Strength of Co-relation:

Po No.	Programme Outcome	strength of co-relation
c	Apply concepts of single and multiloop control system and automatic control for the operation of processes	3
e	Understand and utilize the different types of process and their control	3
f	Use advanced control methods, tools, software and equipmentôs to design and analyze problems process loops.	2
j	Follow industrial process, safety norms, standards and work to benefit environmental and societal context.	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course content

Process Characteristics

Types of processes (dead time, single & multi capacity, self & non-self-regulating, interacting & non-interacting, Linear & non-linear), process gain, process reaction curve, process time constant & constant step analysis method for finding time constant, dead time, dynamic elements in control loops, PID control of processes, process simulator. Incentives for process control, Process Variables types and selection criteria, Process degree of freedom, Characteristics of physical System: Resistance, Capacitive and Combination of both. Elements of Process Dynamics

Analysis of Control Loops

Steady state gain, Process gain, Valve gain, Process time constant, Variable time Constant, Transmitter gain, Linearizing an equal percentage valve, Variable pressure. Analysis of Liquid Level Control, Temperature control.

Feedback Control

Elements of the feedback Loop, Block Diagram, Response to Set-point changes and Disturbances, Control Performance Measures, Selection of Variables for Control Approach to Process Control. Factors in Controller tuning, determining Tuning Constants for Good Control Performance, Correlations for tuning Constants, Fine Tuning of the controller tuning Constants. The performance of feedback Systems.

Multi Loop control

Basic principles and working Implementation issues of Cascade control, Feed forward control, feedback-feedforward control, Ratio control, Selective Control, Split range control. Examples and any special features of the individual loop and industrial applications.

Multivariable Control

Concept of Multivariable Control: Interactions and its effects, Modeling and transfer functions, Influence of Interaction o the possibility of feedback control, important effects on Multivariable system behavior Relative Gain Array, effect of Interaction on stability and Multiloop Control system. Multiloop control Performance through: Loop Paring, tuning, Enhancement through Decoupling, Single Loop Enhancements

Text Books:

1. Process control Systems,F.G. Shinskey, TMH
2. Chemical Process Control,George Stephonopolous, PHI.
3. Process Control: Modeling, Design and Simulation,B. Wayne Bequette, PHI.

Reference Books:

1. Instrument Engineers Handbook: Process Control, Bela G Liptak, Chilton, 3rd ed, 1995.
2. Applied Instrumentation in process industries, William Andrews, Gulf, 2 nd., 1979
3. Control Valve Handbook, Fisher Control International Inc., 3rd.,2001.
4. Process Instrumentation and control Handbook, Douglas M. Considine, McGraw- Hill, 1984.
5. Computer based Industrial Control, Krishna Kant, Prentice Hall of India, 1st., 2009
6. Process Instrumentation and control Handbook ,Considine
7. Applications concepts of Process Control ,Murrill ISA
8. Fundamentals of Process Control,Murrill ISA
9. Feedback controllers: Tuning, Applications& Design, F. G. Shinskey, McGraw- Hill, 4th ed, 2010
10. Automatic Process Control, Donald Eckman, Wiley Eastern Limited.
11. Process Control- Designing processes and Control Systems for Dynamic Performance, Thomas E Marlin, McGraw-Hill International.

IN453A POWER PLANT INSTRUMENTATION

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

The course focuses on different types of power plants. The necessity of power plant automation and different process and their Instrumentation requirement

Course Objectives:

1. The create awareness of energy recourses and its scenario in India.
2. The study of concept of power generation using various resources.
3. To study the role of instrumentation in power plant.
4. To study the compare various power plants for optimal performance.

Course Outcomes:
After completing of course students will able to:

1. understand the overview of different power plants and it operation.
2. understand the application of instrumentation for measurement, monitoring and safety of human being and assent of power plants.
3. discharge the technical duties in field of power generation as maintenance and automation engineer.
4. understand the safety awareness through latest through latest safety equipmentôs.
5. use latest software and tools of instrumentation for power plant.

Relevance of PO's and Strength of Co-relation:

PO. No.	Programme Outcome	strength of co-relation
c	Apply concepts of control system and automatic control for the operation of processes	1
e	Understand and apply the different control strategies in power plants	3
f	Use modern engineering controls, software and equipmentôs to design and apply to the power plants	2
j	Follow industrial safety norms and work to benefit environmental and societal context.	2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to Power Plant Power plant terminologies and key terms, power plant classification: thermal, hydro, nuclear, co- generation, comparison of various power plants based on technology, usage, efficiency, and limitations, Electrical power systems, National Grid and regional pear grid.

Thermal power plant

Various ancillaries used in steam generation units, viz. water treatment, electro-static precipitator, soot blower, economizer, de-aerator, super heater, chemical dosing systems, air pre-heater, coal and ash handling systems, fuel storage and distribution, bag house filters..

Boiler Instrumentation

Types of boilers, various control such as: combustion control, air to fuel ratio control, 3-element drum level control, steam temperature and pressure control, O2/CO2 in flue gases, furnace draft, boiler interlocks, sequence event recorder, supervisory control, data acquisition controls, burner management systems and controllers, start-up and shut-down procedures, boiler safety standards, boiler inspection procedures, Boiler load calculation, boiler efficiency calculation

Turbine Instrumentation

Turbine Instrumentation Turbine instrumentation and control, start-up and shut-down, thermal stress control, turbine supervisory instrumentation, condition monitoring, generator, power distribution instrumentation.

Nuclear Power Plant Instrumentation:

Classification of nuclear reactors, nuclear reactor control loops, fuel cycle, control and safety instrumentation, reliability aspects and various modes of operations.

Non-conventional energy sources and Power Distribution Schemes:

Wind power, solar power, tidal power, diesel generator controls, substation automation and smart grid, energy harvesting

Text Books:

1. The Control of Boilers, Sam. G. Dukelow, ISA Press, New York, 2nd ed, 1991.
2. Boiler Control Systems, David Lindsley, McGraw Hill, New York, 1st ed, 1991

Reference Books:

1. Power Plant Engineering, Manoj Kumar Gupta, PHI Learning Private Limited, 1st ed, 2012.
2. Non-Conventional Energy Resources, G.S. Sawhney, PHI Learning Private Limited, 1st edition, 2012.
3. Power Plant Performance, Gill A.B, Butterworth, London, 1st ed, 1984.

IN453B AGRICULTURAL INSTRUMENTATION

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description: This course describes instrumentation for agriculture industry. Various SCADA used for agriculture application. it also includes study of soil.

Course Objectives:

1. Understand sensors used in agriculture field
2.. Know continuous and batch process
3.. Know greenhouse automation schemes

Course Outcomes:

Upon completion of this course, student should be able to

1. demostrate soil properties and sensors used to measure.
2. demonstrate continuous and batch process.
3. develop automation scheme for green house.

Relevance of PO's and Strength of Co-relation:

PO. no.	Programme Outcome	strength of co-relation
c	Apply concepts of control system and automatic control for the operation of continuous and discrete systems.	2
e	Understand and utilize programmable logic controllers (PLC), distributed control systems (DCS) and supervisory control systems for control of manufacturing and processing systems	2
f	Use modern engineering tools, software and equipments to design and analyze problems.	3
h	Communicate effectively and work in multidisciplinary teams.	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to Agricultural Instrumentation`

Necessity of instrumentation & control for agriculture, engineering properties of soil: fundamental definitions & relationships, index properties of soil, permeability & seepage analysis, shear strength, Mohrôs circle of stress, active & passive earth pressures, stability & slopes, Sensors: introduction to sonic anemometers, hygrometers, fine wire thermocouples, open & close path gas analyzers, brief introduction to various bio-sensors.

Irrigation Systems

Irrigation systems: necessity, irrigation methods: overhead, centre pivot, lateral move, micro irrigation systems & itôs performance, comparison of different irrigation systems, soil moisture measurement methods: resistance based method, voltage based method, thermal based method, details of gypsum block soil moisture sensor, irrigation scheduling, irrigation efficiencies, design considerations in irrigation channels.

Batch Processes

Flow diagram of sugar plant & instrumentation set up for it, flow diagram of fermenter & control(batch process),flow diagram of dairy industry & instrumentation set up for it, juice extraction control process & instrumentation set up for it.

Automation in Green House

Application of SCADA for DAM parameters & control, irrigation control management up-stream & down - stream control systems, green houses & instrumentation: ventilation, cooling & heating, wind speed, temperature & humidity, rain gauge carbon dioxide enrichment measurement & control.

Automation in Earth moving equipments

Automation in earth moving equipments & farm equipments, application of SCADA & PLC in packing industry and cold storage systems, implementation of hydraulic, pneumatic & electronics control circuits in harvesters cotton pickers, tractor etc. classification of pumps: pump characteristics, pump selection & installation.

Agro metrological Instrumentation

Leaf area length evaporation, transpiration, temperature, wetness & respiration measurement & data logging, electromagnetic radiations photosynthesis, infrared & UV bio sensor methods in agriculture, agro metrological instrumentation weather stations, surface flux measurement, soil water content measurement using time-domain reflectometry (TDR),ground water occurrence confined & unconfined aquifers, evaluation of aquifer properties, ground water recharge.

Text Books:

1. Process control and instrumentation technology, C.D. Johnson, PHI.
2. Non-Conventional Energy Resources, G.S. Sawhney, PHI Learning Private Limited, 1st ed., 2012.
3. Process Instrumentation and control handbook, Considine D. M., McGraw Hill publication.

References Books:

1. Instrumentation Engineers handbook- process measurement volume1 and process control volume 2ò, B.G.Liptak, Chilton Book Company, 2001.

2. Mineral Processing Technology, Wills B.A., Pergamon Press, 4th Edition.

IN453C COMPUTER NETWORKS

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

This Course introduces fundamentals of computer network sand topologies, protocols, Internet and World Wide Web.

Course Objectives:

1. Introduction to Computer networks and their topologies.
2. Understand role of protocols in networking and communication.
3. Gain the knowledge about Internet and world wide web.

Course Outcome:

After completion of course students will be able to:

1. understand different network topologies, their design and applications.
2. analyze the design issues of different layers of protocols.
3. recognize different networking devices and their functions.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	An ability to apply knowledge of mathematics, science, and engineering.	**1**
e	An ability to identify, formulates, and solves engineering problems	**1**
f	Use modern engineering tools, software and equipments to design and analyze problems.	**2**
l	An ability to work professionally in both software and hardware system areas including the design and realization of such systems	**3**

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

Course Content

Introduction
Introduction in Computer Networks and Devices, Structure of communication network, Point to point and multidrop circuits, Network topologies, Hub, switch, router, bridges, additional network components. Network Models. Network software, OSI reference model, TCP/IP reference model, and comparison of OSI and TCP/IP model.

Physical Layer and Data link Layers: Transmission media, wireless transmission, geostationary communication satellite, modems, RS ï 232C serial interface, SONET/SDH, data link layer: data link layer design issues, error detection and correction, elementary data link layer protocols, sliding window protocols, SDLC and HDLC

Medium access sub layers and Network Layer: the channel allocation problem, multiple access protocols, ethernet, bluetooth, bridges, high speed LANôs, network layer: need of network layer, network layer design issues, routing algorithms, congestion control algorithms.

Transport Layer and Application Layer: Transport service, Elements of transport protocols, The internet transport protocols ï UDP, TCP ï Introduction, Services, TCP segment header, connections, Transmission policy and congestion control. Application Layer: DNS ï Domain name system, Electronic mail, World Wide Web, Multimedia.

Internet
Internet Working: Concatenated virtual circuits, connectionless internetworking, tunneling, Internet work, routing, fragmentation, and firewalls. Internet and its main applications, Broadband, ISDN and ATM and its reference model. Internet Protocols: IPv4, IPv6, IP address, Internet control protocols ï ICMP, ARP, RARP.

Text Books:

1. Computer Networks , Andrew Tanenbaum, , Pearson LPE /PHI, 4th edition.
2. Computer Networks: Principles, Technologies and Protocols, Irvine Olifer, Wiley India.

References Books:

1. Data Communications and Networking, Behrouz Forouzan, TMH, 4 th Ed.
2. Data Communication and Networks an Engineering Approach ,Irvine, Wiley India
3. An Engineering Approach to Computer Networking ,S. Keshav, Pearson Education, 5th Edition

IN453D NEURAL NETWORK & FUZZY LOGIC INSTRUMENTATION

Teaching Scheme: 03L Total: 03 **Credits:** 03

Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100

Duration of ESE: 03Hrs

Course Description:

This course introduces the basic theories and techniques for neural network and fuzzy logic. The course is primarily meant to develop on hand experience in applying these basics to the detail neural and fuzzy logic instrumentation.

Course Objectives:

1. To expose the students to the concepts of feed forward neural networks.
2. To provide adequate knowledge about feedback neural networks.
3. To teach about the concept of fuzziness involved in various systems. To provide adequate knowledge about fuzzy set theory.
4. To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm.
5. To provide adequate knowledge of application of fuzzy logic control to real time systems.

Course Outcomes:

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

1. develop in students the skills to gain a basic understanding of neural network theory and fuzzy logic theory.

2. explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers.

3. develop and implement a basic trainable neural network or a fuzzy logic system for a typical control, instrumentation application.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of science, mathematics to acquire an appreciation for neural and fuzzy based system and controller and techniques and be able to apply these techniques to real world problems.	**3**
d	Apply the concepts of neural and fuzzy logic for various applications of neural based and fuzzy based system and controller in industry, medicine, and defence.	**2**
f	Use modern engineering tools, software and equipments to design and analyse problems.	**2**
g	Participate and succeed in competitive examinations and engage in life-long learning.	**1**

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction Neural Networks

Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro- associative memory.

Back propagation networks

Perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications

Introduction Fuzzy Logic

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Fuzzy Membership & Rules

Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.

Fuzzy Logic Based Control

Fuzzy Controllers: Preliminaries ï Fuzzy sets in commercial products ï basic construction of fuzzy controller ï Analysis of static properties of fuzzy controller ï Analysis of dynamic properties of fuzzy controller ï simulation studies ï case studies ï fuzzy control for smart cars.

Neuro – Fuzzy based system & controller

Neuro ï Fuzzy and Fuzzy ï Neural Controllers Neuro ï fuzzy systems: A unified approximate reasoning approach ï Construction of rule bases by self-learning: System structure and learning algorithm ï A hybrid neural network based Fuzzy controller with self-learning teacher. Fuzzified CMAC and RBF network based self-learning controllers.

Text Books:

1. Neural Networks, Fuzzy Logic and Genetic Algorithm:Synthesis and Applications, S. Rajsekaran& G.A. VijayalakshmiPai, Prentice Hall of India.
2. Fuzzy Logic with Engineering Applications ,Timothy J. Ross, Wiley India.
3. Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence, Kosco B, Prentice Hall of India, New Delhi, 1992.
4. Introduction to Artificial Neural Systems , Jacek M. Zuarda, Jaico Publishing House, 1997.

5. Fuzzy sets, Uncertainty and Information, Klir G.J and Folger T.A, Prentice Hall of India, New Delhi 1994.

References:

1. Neural Networks. Siman Haykin, Prentice Hall of India
2. Artificial Intelligence and Intelligent Systems, N.P.Padhy, Oxford University Press.
3. Neural Networks, Kumar Satish, Tata McGraw Hill
4. Artificial Neural Networks, Bose and Liang, Tata Mc-graw Hill, 1996.
5. Neural Networks, Simon Haykin, ISA, Research Triangle Park, 1995

IN454A OPTIMAL AND ADAPTIVE CONTROL

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

This course introduces the basic theories and techniques of optimal control systems and adaptive control systems which are useful in process industries for control. The Course is designed in such way that the students can acquire the concepts of controller design using advanced control concepts of adaptive. The students also get knowledge of optimization which is important part in any industry to solve the problems.

Course Objectives:

1. To educate on formulation of optimal control problems and introduce the minimum principle
2. To educate on Linear Quadratic tracking problems- in continuous and discrete domain
3. To introduce the numerical techniques used for solving optimal control problems
4. To educate on the concepts of self tuning regulators and model reference adaptive systems.
5. To educate various case studies such as pendulum, robot are etc for analysis purpose.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. understand optimal theory and the role of optimal control in controller design.
2. acquire the fundamental as well as advanced concepts of Adaptive Control.
3. analyze the case studies of various applications to study the general concepts of processes and systems.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of science, mathematics and modelling to analysis and design a real time problems.	3
d	Apply the concepts of optimal theory for various applications such as pendulum, robot ara, heat exchanger, distillation column etc	3
f	Use modern engineering tools, softwares and DAQ to Systems design and analyse.	1
g	Participate and succeed in Control and Automation. This course is also useful for higher studies and life-long learning.	2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction

Statement of optimal control problem, Problem formulation and forms of optimal Control, Selection of performance measures. Necessary conditions for optimal control : Pontryaginôs minimum principle, State inequality constraints, Minimum time problem.

Linear Quadratic Tracking Problems

Linear tracking problem, LQG problem, Computational procedure for solving optimal control problems, Characteristics of dynamic programming solution, Dynamic programming application to discrete and continuous systems, Hamilton Jacobi Bellman equation.

Numerical Techniques for Optimal Control

Numerical solution of 2-point boundary value problem by steepest descent and Fletcher Powell method solution of Ricatti equation by negative exponential and interactive Methods

Adaptive Control and Adaptation Techniques

Introduction, Auto tuning, Self Tuning Regulators (STR), Model Reference Adaptive Control (MRAC), Types of STR and MRAC, Different approaches to self tuning regulators , Stochastic Adaptive control, Gain Scheduling.

Case Studies

Inverted Pendulum, Robot arm, process control application: heat exchanger, Distillation column, application to power system, Ship steering control.

Introduction to Optimization

Definition, Classification of optimization problems, Classical Optimization Techniques, Single and Multiple Optimization with and without inequality constraints. Introduction to Simplex and revised method of solving LPP.

Text Books:

1 Optimal Control Theory ï An introduction, . Kirk D.E., Prentice hall, N.J., 1970.

2. Adaptive Control, Astrom and Wittenmark, PHI

3. Optimization Theory with applications, Pierre D.A., Wiley Publications,1969.

Reference Books:

1. Introduction to Stochastic Control Theory, Astrom, K.J, Academic Press, Inc, N.Y., 1970.
2. Linear Systems Optimal and Robust Control, Alok Sinha, CRC Press, First Indian Reprint,2009.
3. Optimum System Control, Sage, A.P, Prentice Hall N.H, 1968.
4. Control Hand Book,William S. Levine,
5. Stable Adaptive Control Systems, Narendra and Annasamy, Prentice Hall, 1989.
6. Operations Research: An Introduction, Taha, H. A., Pearson Education Edition, Asia, New Delhi , 7 th Edition, 2002.
7. Optimization ï Theory and Applications, S.S. Rao, Wiley-Eastern Limited, 1984.

IN454 B MEMS and Nano Instrumentation

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

The course explores basic concepts of MEMS, Nano-devices and various sensors. It also provides knowledge about the applications of nanotechnology.

Course Objectives:

1. Students should learn and understand the basic concept s of MEME and Nano-devices and various sensors.
2. Students should acquire knowledge about the applications of nanotechnology.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. understand the working of MEMS and NEMS.
2. understand the applications of Nano-sensors and detectors.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of Science, mathematics and electrical / electronics to measurement and control systems.	**3**
d	Apply the concepts of digital, analog electronics, microprocessor systems and functionality of system components/devices for the automation of processes.	**2**
f	Use modern engineering tools, software and equipments to design and analyze problems.	**2**
g	Participate and succeed in competitive examinations and engage in life-long learning.	**1**

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Micromachining

Cantilever, beam, diaphragm, MEMS Silicon pressure sensor, MEMS Piezoresistive pressure sensor, Silicon accelerometer, Microfabrication, IC Processes, Photolithography, Silicon crystallographic concepts and etching, structures in materials other than Si, Surface micromachining, Bonding,

MEMS based Micro sensors

Micro-sensors based on different scientific effects, Identical multi-sensors, Non-identical multi-sensors, sensors with self check and self calibration, Flow, temperature sensors, MEMS based magnetic sensors, Stiction, Micro dispenser, Mechanics of cantilevers / beams / diaphragms, Micro actuators

Nanotechnology

Basic science behind nanotechnology, Carbon, Graphite, Diamond, Fllerenes, Graphene, Carbon Nanotubes, Nanomaterials, Nanofabrication, Top down fabrication methods- Arc discharge method, Laser Ablation Method, Ball Milling, Inert Gas condensation, Bottom-up fabrication methods- Homogeneous nucleation, Chemical vapour deposition, Molecular beam epitaxy, Sol-Gel method, Hydrothermal synthesis, Microwave Method,

Nanoscale characterization

Scanning Electron Microscope, Transmission Electron Microscope, Scanning Tunnelling Microscope, Atomic Force Microscope, X-ray diffraction, Raman Spectroscopy.

Nanoelectronics

Electronic devices based on Carbon Nanotubes and Graphene, CNT Transistor, CNT FET, Optoelectronic nanodevices, Spintronics, Physical principles of Spintronic devices, Spin relaxation mechanism, Spin injection, Spin Detection, Spin filters, Spin valves, Spin pumps, Spin diodes, Spin Transistors, Molecular and biological nanodevices

Text Books:

1. MEMS & Microsystems Design & Manufacture , Tai-Ran Hsu, Tata McGraw-Hill Education
2. Nanotechnology, The science of small ,M. A. Shah and K. A. Shah, Wiley publication.
3. Nanoelectronics: Principles and Devices, Mircea Dragoman, Diniela Dragoman, Artech House, Boston ,2006

Reference Books:

1. Nanotechnology: An introduction to nanostructuring technique,Michael Kolher, Wolfgang Fritzsche,Wiley-VCH ,2007
2. Handbook of Nanotechnology,Bhusan (Editor) Springer, Berlin Heidelberg New York, 2010
3. EE701(Introduction to Micro-Electro-Mechanical-System MEMS) Course Notes, Prof. Prakash R. Apte, EE Department, IIT Bombay, Mumbai;

IN454C AUTOMOTIVE INSTRUMENTATION

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

The course provides the fundamental knowledge of principal of electronics and to introduce the application of electronics in modern automobile. It also deals in understanding of automotive system and various electronic accessories used in automobile.

Course Objectives:

1. To learn the fundamental principles of electronic and to introduce the application of electronics in modern automobile.
2. To develop the ability to understand various latest communication protocols used in Automobile industries.
3. To provide a thorough understanding of automotive system and various electronic Accessories used in automobile.

Course Outcomes:

Upon successful completion of this course the students will be able to

1. analyze the use of instruments in automotive industry.
2. design instruments for automotive applications.
3. use communication protocols to perform advanced monitoring and control.

Relevance of PO's and strength of co-relation:

PO. No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of Science, mathematics and electrical / electronics to measurement and control systems.	2
c	Apply concepts of control system and automatic control for the operation of processes	3
f	Use modern engineering tools, software and equipmentôs to design and analyse problems.	1
j	Follow industrial safety norms and work to benefit environmental and societal context.	2

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

Course Content

Fundamentals and automotive electronics

Introduction to Automobile industry and plant. Open loop and closed loop system component for electronic engine management. Vehicle motion control, current trends in modern automobiles.

Electronic fuel injection and ignition systems

Introduction, carburetor control system, throttle body ignition and multi-port and point fuel injection, advantages of electronic ignition system, types of solid state ignition system and their principle of operation, electronic spark timing control system.

Engine control system

Engine cranking and warm up control, acceleration enrichment De-acceleration leaning and idle speed control, integrated engine control system, exhaust emission control system, engine performance testing automobile chassis electronic control system, principle of electronic braking, automatic transmission electronic control circuit, cruise control circuit, the electronic steering control theory, ABS, ASR, ESP and other electronic control method.

Auto body electronic control technology

Automotive central locking and anti-theft system control technology, electronically controlled windows and doors and airbag technology, principle of control circuit components and characteristics.

Ergonomics and safety

Driver information system, lighting system component, battery monitoring and control, air conditioning, steering control techniques, automatic gear control system, Emission Standards.

Text Books:

1. Understanding Automotive Electronics, William B. Riddens, William B. Riddens, 5th Edition, 1998
2. Automobile Engineering Volume-I&II, PritamSingh Gill, SK and Son Publication
3. Automobile Engineering Volume-I&II, Dr. Kirpal Singh, Publication

Reference Books:

1. Sensors applications,sensors for automotive Technology, Jiri Marek,Hans Peter trah, 1st Edition.
2. Automotive Electronics System, T.Mellard Heinenmann Professional,1987
3. Automotive Computers and Control system, Tom Weather Jr and Cland C. Hutter, Prentice Hall Inc.New Jeresy

IN454 D EMBEDDED SYSTEM

Teaching Scheme: 03L Total: 03 **Credits:** 03
Evaluation Scheme: 10 ISA + 15 ISE1 +15 ISE2 + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

Course Description:

An Embedded system is a system that has embedded software and computer hardware, which makes it a system dedicated for an application(s) or specific part of an application or product or part of an application or product or part of a larger product.

Course Objectives:

3. Student can hone his/her problem solving and system design skills using modelling practices and learn more key concepts in embedded hardware architecture, interfaces, buses, software programming design and RTOSes..
4. Imparting knowledge about the fundamental aspects that form the basis of hardware and software designing of embedded systems.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. learn insight into the fundamental aspects that form the basis of hardware and software designing of embedded systems.
2. learn embedded system with real word applications.
3. understand embedded hardware architecture, interfacing techniques, buses and protocols, hardware and software interrupts, Embedded software programming, modeling, inter-process synchronization and real time operating system.

Relevance of PO's and strength of co-relation:

Po No.	Programme Outcome	strength of co-relation
a	Demonstrates basic knowledge in concepts of Science, mathematics and electrical / electronics to measurement and control systems.	**3**
d	Apply the concepts of digital, analog electronics, microprocessor systems and functionality of system components/devices for the automation of processes.	**2**
f	Use modern engineering tools, software and equipments to design and analyze problems.	**2**
g	Participate and succeed in competitive examinations and engage in life-long learning.	**1**

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction to Embedded system

Embedded system, Embedded hardware units, Devices and software in a system, Examples of embedded system, Embedded SOC, Design process in embedded system, Design examples, Classification, Advanced architectures, Processor and memory organization and selection.

Devices, Communication Bus, Device Driver, Interrupt

IO Types, Serial communication Devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems, Serial bus communication protocols, Parallel bus device protocols, Internet enabled systems Network protocols, Wireless and mobile system protocols, ISR concept, Interrupt sources and handling, Multiple interrupts, Context, context switching, Interrupt latency and deadline, Direct Memory Access

Programming Concepts, Embedded Programming, Program Modeling and Interprocess Communication and Synchronization of Processes

Software programming in Assembly Language (ALP) and in High Level Language ćCĉEmbedded programming in C++, Embedded Programming in Java, Programs Models, DFG Model, State Machine Programming Models for Event controlled Program Flow, Modelling of Microprocessor System, UML Modelling, Multiple processes in an Application, Multiple Threads in an Application, Task and Data, Concepts of Semaphores, Shared Data, Interprocess Communication, Signal Functions, Semaphore Functions, Message Queue Functions, Mailbox Functions, Pipe Functions, Socket Functions, RPC Functions

Real Time Operating Systems and programming

OS Services, Process Management, Timer Function, Event Function, Memory Management, Device, File and IO Subsystems Management, Interrupt Routines in RTOS Environment and Heading of Interrupt source Calls, Real Time Operating System, Basic Desing Using an RTOS, RTOS task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Metrics, OS Security Review, Basic Function and Types of RTOSES, RTOS mCOS-II, RTOS Vxworks

Embedded Software Development Process and Tools

Introduction to Embedded Software Development and Tools, Host and target Machines, Linking and Locating Software, Getting Embedded Software into the Target System, Issue and Hardware-Software Design and Co-Design, Testing, Simulation and Debugging Techniques and Tools, Testing and Host Machine, Simulators, Laboratory Tools

Text Books

1. Embedded Systems, Architecture, Programming and Design , Raj Kamal ,TMH
2. Fundamentals of Embedded software, Daniel W. Lewis, Prentice Hall of India

Reference Books

1. An Embedded software primer, David E. Simon, Pearson Education
2. Embedded System Design ï A unified hardware and software Introduction, Frank Vahid, John Willey
3. Embedded Real Time Systems Programming, Sriram V. Iyer, Pankaj Gupte, Tata McGraw Hill
4. Embedded System Design, Steve Heath, 2 nd edition

IN455 INSTRUMENTATION SYSTEM DESIGN LAB

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

Course Description:
Instrumentation design deals with specification of equipment, layouts, wiring. All activity handled by instrumentation design engineer. The course provides an overview of static and dynamic performance characteristics of instruments. Selection criteria for flow, temperature transducers. Design considerations for transducers such as thermocouple, RTD, orifice plates, Rota meter. It also includes design of controllers and control panels.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN451. The list given below is just a guideline

1. Design of signal conditioning circuit for resistive displacement transducer.
2. Design of signal conditioning circuit for Capacitive/Inductive displacement transducer.
3. Design signal conditioning circuit for strain gauge
4. Design of signal conditioning for load cell
5. Design of signal conditioning circuit for RTD (Pt-100)
6. Design of signal conditioning for thermocouple (J/K/R/S/T/E Type)
7. Calibration of I/P & P/I converter
8. Calibration of D.P. Transmitter for flow
9. Calibration of D.P. Transmitter for level
10. Smart transmitter.
11. Enclosure design for circuit and instrument.
12. Design electronic PID controller

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on oral performance of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN456 PROCESS INSTRUMENTATION LAB

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50

Course Description:

This lab course provides the knowledge of different processes and controlling of the various Parameters and tuning the Controllers for optimum performance of the process used in Industries.

Minimum Ten experiments/Programs shall be performed to cover entire curriculum of course IN452. The list given below is just a guideline

1. Develop a FOPDT/SOPDT model of any process.
2. Effect of control actions on system with dead time and integrating systems (Using Scilab/LabVIEW MATLAB).
3. Flow control loop.
4. Level control loop
5. Temperature control loop.
6. Pressure control loop.
7. Finding best tuning values based on any performance criteria.
8. Cascade control loop.
9. Ratio control loop.
10. Time constant of single capacity process.
11. Selective control loop.
12. Time constant of Interacting and non-interacting of process

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.

- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN457A POWER PLANT INSTRUMENTATION LAB

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50

Course Description:

Instrumentation play important role in power plants where instrumentation used as controlling and monitoring of various operation. The course explores the overview of different power plants and knowledge of different measuring instrument and monitoring instruments are used in power plants. The type and measuring methods changes with respect of type of power plants. The course provides the knowledge of different of instruments use for electrical, Thermal and hydraulic system.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN453A. The list given below is just a guideline.

Note: Visit to power plant is expected and the report on the same should be submitted as a part of Laboratory work.

List of Experiment:

1. Instrumentation for Hydro-electric/thermal power plant.
2. Instrumentations for safety in Nuclear power plants.
3. Solar power analyzer for solar power plants.
4. Wind flow meter for wind power plants.
5. Design and development of interlocks and safety system for thermal power plants.
6. Selection of instrumentation system for thermal power plant.
7. Design of boiler automation using DCS and PLC
8. Boiler safety instrumentation.
9. Turbine control system.
10. Regional/National power grid.
11. Case study of Non-Conventional Energy scenario in India

ICA – Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.

ESE – The End Semester Examination (ESE) for this laboratory course shall be based on oral performance of students based on the experiments/visits performed by student in the semester. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN457B AGRICULTURAL INSTRUMENTATION LAB

Teaching Scheme: 02PR Total: 02 **Credits:** 01
Evaluation Scheme: ICA 25Marks + ESE 25 MARKS **Total Marks:** 50
Duration of ESE: 03Hrs

Course Description:

In this laboratory, course emphasis will be on various instrumentation used in Agriculture field

Minimum Ten experiments shall be performed to cover entire curriculum of course IN453B with visit to fertilizer plant/ food plant/ biotech/Agro processing plant. The list given below is just a guideline

List of Experiment:

1. Determine Soil Humidity using Hygrometer.
2. Determine wind speed by using sonic anemometer.
3. Determine amount of Gas produced by each digester by GAS Analyser.
4. To monitor temperature of agriculture green house by Temperature Sensor.
5. To monitor light efficiency of agriculture green house by Light Sensor.
6. To measure soil properties of soil by sensor.
7. Design a biosensor for agriculture field.
8. Case Study: Batch process for Sugar Plant and Instrumentation for it.
9. Case Study: Juice extraction Process and Instrumentation for it.
10. Design SCADA System for Agriculture irrigation.
11. To measure soil water content using time domain reflectometery.
12. Design a Control Panel for Automation in earth moving equipment and farm equipment.

ICA – Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.

ESE – The End Semester Examination (ESE) for this laboratory course shall be based on oral performance of students based on the experiments/visits performed by student in the semester. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN457C COMPUTER NETWORKS LAB

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

Course Description:

This Course introduces fundamentals of computer networks and topologies, protocols, Internet and World Wide Web. Their practical applications and use in routine life.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN453C. The list given below is just a guideline

Note: Following experiments shall be performed using laboratory setup and the campus wide network available in the institute.

List of Experiment:

1. Study of network topologies and various components involved in it.
2. Study of Two/Three tier architecture of computer networks.
3. Demonstrate data transfer through Programmable Core, Aggregation and access switches.
4. Interconnection of personal computers and PSTN (Public switching Telephone Networks) using MODEMS.
5. Integrate and test data transfer and sharing resources in LAN.
6. Study of WAN.
7. Demonstration of wireless communication technology through Bluetooth technology.
8. Study of various applications like Electronic mail, E- commerce, WWW.
9. Study of Network monitoring system like Whatsup Gold.
10. Study of Routers and its role in networking.
11. Demonstrate Unified Threat machines like Cyberoam, Fortigate etc.
12. Demonstration of wi-fi components and Wireless access controller.

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN457D NEURAL NETWORK & FUZZYVLOGIC INSTRUMENTATION LAB

Teaching Scheme: 02P Total: 02 **Credit:** 01
Evaluation Scheme: 25 ICA+ 25 ESE **Total Marks:** 50
Duration of ESE: 03Hrs

Course Description:

This course introduces the basic theories and techniques for neural network and fuzzy logic. The course is primarily meant to develop on hand experience in applying these basics to the detail neural and fuzzy logic instrumentation.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN453D. The list given below is just a guideline

Note: Following experiments/programs shall be performed using laboratory setup and the campus wide network available in the institute.

List of Experiment:

1. Write a program to implement single layer perception algorithm.
2. Write a program to implement back propagation learning algorithm
3. Design multilayer feed forward network using back propagation algorithm
4. Study of fuzzy inference system
5. To study fuzzy logic controller using fuzzy logic toolbox
6. Write a program to implement SDPTA
7. Write a program to implement RDPTA
8. To Study various defuzzification techniques
9. Write a program to implement of fuzzy set operation
10. Applications and analysis of process using fuzzy system.
11. Applications and analysis of process using fuzzy PID system.
12. Applications and analysis of MIMO process using fuzzy system.

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

- **ESE –** The End Semester Examination (ESE) for this laboratory course shall be based on performance in one of the experiments/program performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

IN458 PROJECT PHASE-II

Teaching Scheme: 04Hrs/week **Credit:** 02
Evaluation scheme: 50 ICA+ 100 ESE **Total Marks:** 150
Duration of ESE: 03Hrs

Course Description:

The project is one of the most important swork in the degree programme. It is introduced in curriculum to put into practice some of the techniques that have been taught to students in earlier years. It also provides the opportunity to students to demonstrate independence and originality, to plan and organise a large project over a long period. The project topic should be selected to ensure the satisfaction of the need to establish a direct link between the techniques they learnt and productivity. Thus it should reduce the gap between the world of work and the world of study.

Desirable Awareness/Skills:

Knowledge of concepts, principles and techniques studied in all earlier courses.

Course Objectives:

The objectives of offering this course are:

1. to develop ability to synthesize knowledge and skills previously gained and to put some of them into practice.
2. to make students capable to select from different methodologies, methods and forms of analysis studied to produce a suitable system or sub-system.
3. to inculcate ability to present the findings of their technical solution in a written report.
4. to plan and organize a large project over a long period.

Course outcome:

On successful completion of this course students shall be

1. able to apply the knowledge and skills previously gained into practice.
2. take appropriate decision wrt. various parameters related to production of a system or sub-system.
3. demonstrate the leadership quality along with ability to work in a group.
4. prove the ability to present the findings in a written report or oral presentation.

Relevance of PO's and Strength of Co-relation:

Sr No	PO	Level of co-relation
c	Apply concepts of control system and automatic control for the operation of continuous and discrete systems.	1
e	Understand and utilize programmable logic controllers (PLC), distributed control systems (DCS) and supervisory control systems for control of manufacturing and processing systems.	2
f	Use modern engineering tools, softwares and equipments to design and analyze problems.	1
j	Follow industrial safety norms and work to benefit environmental and societal context.	1

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

Course Content

- The project shall be the extension of Project phase-I carried out in-house i.e. in the departmentôs laboratories/centers by a group 2 ï 4 students.

- The project shall consist of design and implementation of any suitable instrumentation application system, sub system or software based on knowledge and skills previously gained.

- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation.

  Project Deliverables: A project report as per the specified format (available on in the department and institutes website), developed system in the form of hardware and/or software. In addition, student shall maintain a record of attendance and continuous progress (log book in appropriate format available on institute/departmentôs web site) duly signed by course coordinator and present as mini project phase deliverable along with report.

  Evaluation System:

  It includes Internal Continuous Assessment (ICA) and End Semester Examination (ESE).

  Guidelines for ICA and ESE are given bellow.

  Internal Continuous Assessment (ICA)

- A committee comprising of three examiners (one of them should be guide) nominated by head of department, will take the review of the project work twice in the semester. Committee shall judge the students on the principle of continuous evaluation and contribution of individual student in the group. Average of two reviews shall be considered as overall performance of the student
- It shall be evaluated on the basis of deliverables of project and depth of understanding.
- Course coordinator shall maintain the record of continuous evaluation in appropriate format available on institute/departmentôs web site.

End Semester Examination (ESE)

The End Semester Examination for this course shall be based on demonstration of the system or sub system developed completely as extension of project phase-I by the group of students, Deliverables of project and depth of understanding (oral examination) shall be evaluated by two examiners out of which one examiner shall be out of institute. The ESE of Industry sponsored project may be conducted at site if needed.

IN459: INDUSTRIAL VISIT/ INDUSTRIAL TRAINING

Teaching Scheme:00L+00T Total 00 **Credits:** 01
Examination Scheme: 25 ICA **Total Marks:** 25

Course Description

This course gives opportunity to students to explore the knowledge of industry organization, new trends in manufacturing, maintenance and safety and also gives actual work experience with exposure to industrial environment or boosts entrepreneurial aspirations or analytical skills to solve real life problem as per student interest.

Desirable awareness/skills

1. Listening, understanding and analyzing ability along with the knowledge of concepts, principles and techniques studied earlier.

Course Objectives

The objectives of the course are to

1. introduce the basic industries and the process/product development cycle.
2. be familiar with the industrial environment and work culture
3. learn the importance of entrepreneurial skills.
4. emphasizes intuitive understanding and practical implementations of the theoretical concepts

Course Outcomes

On successful completion of this course student shall be able to

1. demonstrate the knowledge of organizational set up of an industry.
2. evaluate and analyze the manufacturing, material handling, maintenance, safety standards and environmental considerations in industry.
3. explore entrepreneurial ways to understand the impact of engineering solutions in a global, economic, environmental and social context.
4. exhibit analytical skills to solve real life problem as per student interest.

Relevance of COs /POs and strength of co-relation

PO No.	POs	Level of co-relation
PO4	**Conduct investigations of complex problems** using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.	2
PO5	**Modern Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an under- standing	3

	of the limitations.	
PO6	**The Engineer and Society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.	2
PO7	**Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.	2
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	3
PO9	**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.	3
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering com- munity and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.	3

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

This course shall be completed preferably during the summer vacation after sixth semester but in exceptional cases can be completed during the winter vacation after seventh semester or during the weekends of seventh semester. **Under any circumstances; this course shall be completed before the commencement of eighth semester.**

Industrial visit Industry visits for minimum four industries local or outstation shall be carried out by each student. Department shall arrange the industrial visits during the summer/winter vacations after sixth/seventh semester or in exceptional cases weekends during the seventh semester. Industries shall be related to solar energy/ power electronics/ telecom sector/ computer hardware-software/ manufacturing/ automobile automation/ bio-tech-agriculture sector/power station, Tv-radio station/ sugar-chemical factory/ any other relevant industry approved by course coordinator.

or

Industrial Training Individual or group of students shall undergo industrial training in any industry of own interest and convenience related to electronics and telecommunication for minimum one week fulltime or two weeks part time so that total training period should be more than 40 hours.

Course Deliverable Every student shall submit the appropriate (visit/training/attendance/visit for special study) certificate along with a report in the format provided by department/course coordinator duly signed by course coordinator and HoD.

Evaluation system

It includes Internal Continuous Assessment (ICA) and Guidelines for ICA are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated by course coordinator appointed by the HoD.
- Course coordinator shall judge the student on the basis of presentation, deliverables of the course described earlier.
- The following format may be used for ICA

Sr No	PRN of Student	Name of Student	Course undertaken	Report	Presentation and Depth of understanding	Total
				10	15	25

Name and Signature of Examiner

IN461 INDUSTRIAL LECTURE

Teaching Scheme: 01 L; Total: 01 **Credit: 0**1
Evaluation Scheme: 25 ICA **Total Marks:** 25

Course Description

This course is designed in continuation with the course IN 361 INDUSTREIAL LECTURES which is taught in sixth semester. It reflects on the importance of acquaintanceships and the interchange of needed information between practicing engineers in industry and students in educational institutions. There is a criticism, especially from practicing engineers, that existing engineering education is too theoretical and numerical with less orientation toward practical aspects. This course is designed to overcome this criticism. This course is intended to generate such interaction directly, through expert lectures by outstanding practicing engineers. This course will prove helpful to denote and understand the relations among the employers, employees, and other organizations.

Desirable awareness/skills

2. Listening, understanding and analyzing ability along with the knowledge of concepts, principles and techniques studied earlier.
3. Should have successfully completed the course IN 361 INDUSTREIAL LECTURES

Course objectives

The objectives of offering this course are

1. to make students familiar with industrial environment i.e. to provide appropriate exposure to world of work.
2. to know and understand the industrial experience, attitudes, needs, and viewpoints of industrial expert to students.
3. to denote and understand the role of various partiesô viz., employers, employees, and state in maintaining industrial relations.
4. to improve industry institute interaction.

Course outcome

On successful completion of this course students shall be able to

1. demonstrate the ability to face industrial environment/ world of work.
2. fulfill expectations of industry wrt expertise, attitude and viewpoint.
3. demonstrate the good inter personnel relations.
4. work in industrial environment either as employee or self-employed (entrepreneur) with comfort.

Relevance of PROGRAM OUTCOMES (Pos) and strength of co-relation

PO No.	POs	Level of co-relation
PO11	**Project Management and Finance**: Demonstrate knowledge and understanding of Engineering and management principles and apply these to oneôs own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2
PO12	**Life-long Learning**: Recognize the need for and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.	2

1-Weakly correlated 2- Moderately correlated 3 - Strongly correlated

Course Content

- There shall be minimum 6 lectures of 60 -90 minutes duration.
- The lecture shall include presentation, informal discussions with students and faculty, and laboratory tours (if required).
- Topics of Industrial Lectures shall be technical in nature and should not be the specific or extended part of the curriculum.
- Typically speakers should talk about:
  i. Their own career following (and sometimes including university).
  ii. Interesting jobs/projects they have had worked on.
  iii. The areas of work they are currently involved in.
  iv. The type of work engineering graduates can expect.
  v. Current job opportunities that may be available for engineering graduates in general and electronics and telecommunication engineering graduates in particular.
  vi. Any suggestions for students with regard to job hunting / CV writing / interviews etc.
  vii. Latest technology used in the industry which is not the part of curriculum or routine training programmes.
  viii. Any other suitable topic/information which provides industrial exposure and improves entrepreneurship quality/ employability of the students.
- Course coordinator shall discuss with students on the content of lecture and may conduct oral or give written assignments to judge the depth of understanding of students.
- Students shall submit the report based on minimum six lectures giving summary of the lecture delivered.
- The summary should contain brief resume of the expert, brief information of his organization and brief summary of the lecture in the format provided by institute/department.
- **Industrial Lecture deliverables:** An industrial lecture report as per the specified format (available on in the department and institutes website) and assignments given by course coordinator (if any).

(**Note:** List of renowned experts/Officials from Industries/Government Organizations/Private Sectors/Public Sectors / R&D Labs etc shall be prepared by the committee appointed by HoD and shall be approved by principal. After approval from the principal, minimum six Industrial Lectures shall be arranged, which shall be delivered by experts to cover the various aspects of course content)

Evaluation system It includes Internal Continuous Assessment (ICA). Guidelines for ICA are given bellow.

Internal Continuous Assessment (ICA)

- The ICA shall be evaluated by course coordinator.
- Course coordinator shall judge the students on the principle of continuous evaluation and contribution of individual student.
- It shall be evaluated on the basis of deliverables of industrial lecture and depth of understanding (oral conducted by course coordinator).
- Course coordinator shall maintain the record of continuous evaluation (oral) and include in the record of sixth semester received from HoD.
- Total of sixth and eighth semester marks shall be converted out of 25.