GOVERNMENT COLLEGE OF ENGINEERING, JALGAON [M.S]

(An Autonomous Institute of Government of Maharashtra)

"Globally Accepted Engineers with Human Skills"

Curriculum for
Third Year B. Tech. Instrumentation
2020-21

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

Department of Instrumetation Engineering

Scheme for Semester V of B. Tech. (Instrumentation Engineering) with effect from academic year 2020-21

Option-II

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme						Credit
							Theory			Practical		Total	
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
IN301U	Control System Components	PC	3	…	…	3	30	10	60	…	…	100	3
IN302U	Microcontroller and Applications	PC	3	…	…	3	30	10	60	…	…	100	3
IN303U	Signals and Systems	PE	3	…	…	3	30	10	60	…	…	100	3
IN304U	Professional Elective- I	PE	3	…	…	3	30	10	60	…	…	100	3
IN305U	Open Elective-I	OE	3	…	…	3	30	10	60	…	…	100	3
IN306U	Control System Components Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN307U	Microcontroller and Applications Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN308U	Virtual Instrumentation Lab	PC	1	…	2	3	…	…	…	25	25	50	2
IN309U	Professional Elective- I Lab	PE	…	…	2	2	…	…	…	25	25	50	1
IN310U	Industrial Visit / Enterpreunership Development Program (EDP) / Case Studies	PS	1	…	2	3	…	…	…	50	…	50	2
IN453U	**Professional Elective - V**	**PE**	**3**	**…**	**…**	**3**	**30**	**10**	**60**	**…**	**…**	**100**	**3**
IN456U	**Professional Elective-V Lab**	**PE**	**…**	**…**	**2**	**2**	**…**	**…**	**…**	**25**	**25**	**50**	**1**
Total			**20**	**0**	**12**	**32**	**180**	**60**	**360**	**175**	**125**	**900**	**26**

Professional Elective-I

- **A.** Power Electronics and Drives
- **B.** Power Plant Instrumentation
- **C.** BioMedical Engineering
- **D.** Navigational Instrumentation

Open Elective-I

- **A.** Virtual Instrumentation
- **B.** Network Control System (PLC and DCS)
- **C.** Introduction to BioMedical Engineering
- **D.** Operations Research

Professional Elective-V

- **A.** Embedded System
- **B.** Fiber Optics & Laser
- **C.** Artificial Intelligence
- **D.** Human Ergonomics

L : Lecture **T: Tutorial** **P: Practical** **MSE: Mid Semester Examination**

ISA :Internal Sessional Assessment **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

Note: **1. ESE (TH) duration for all theory courses is three hours.**

2. MSE (TH) duration for all theory courses is two hours

IN301U CONTROL SYSTEM COMPONENTS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course provides knowledge about different control system components like various types of transmitters and converters. It gives brief introduction to control valves and the study of various control modes controllers like PID.

COURSE OBJECTIVES:

1. To understand the basic principle of control system components of different systems.
2. To understand the basic principle of controllers.
3. The objective of the course is to provide students with a firm grasp of the essential principles of control system components.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Acquire the knowledge of system of units, classification and essentials of measuring instruments.	01,02	Remembering, Understanding
CO2	Design the construction and operation of various measuring instruments.	01,02	Remembering, Understanding
CO3	Identify the measuring instruments and apply them for quantifying measurements of parameters.	02	Understanding
CO4	Analyse and select proper instrument for given application	03	Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2

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

Course Content

Introduction to Control System Components

Comparison of different systems: hydraulic, pneumatic and electronic systems, 2-wire transmitters, buoyancy, differential pressure transmitters, temperature, electro-hydraulic transmitters, resistance-to-current converter, voltage-to-current convertor, pneumatic to electric converter, electrical to pneumatic converter, square root extractor, integrator and totalizer.

Control Valves

Terminology, types and characteristics, selection of control valves, concept of Cv, calculation of Cvand trim size, cavitations and flashing, noise in control valves, testing of control valve, valve positioners, necessity, types and effect on performance of control valves, electrical, pneumatic and hydraulic actuators, electro-pneumatic and electro-hydraulic actuators.

Pneumatic and Hydraulic Components

Instrument air supply, air filter regulator, simple pneumatic circuits, and fluidic gates, linear motors(piston- cylinder), rotary motors, non-return valves, directional control valve, pressure reducing valves, hydraulic power pack, pumps, simple hydraulic circuits and transmission. power cylinders, servomotors, DC valves.

Controller Principles

Process characteristics, process equation, process load, process lag, self regulation, control system parameter, error, variable range, control parameter range, control lag, dead time, cycling, controller modes, two position mode, multi-position mode, floating control mode, proportional control mode, integral control mode, derivative control mode, PI, PD, PID, its tuning, implementation of control modes in pneumatic, hydraulic, and electronics.

Auxiliary Components

Synchros, servo motor, stepper motor, feeders and dampers, intrinsic safety and components, gyroscope, indicators and alarm annunciator, control panel and their design. **Oscilloscope:** General purpose oscilloscope, construction, front panel controls, deflection sensitivity, dual trace CRO, measurement of electrical parameters like voltage, current, frequency, phase, Z-modulation, digital storage oscilloscope.

Text Books:

1. Industrial Electronics by Petruzella, first edition, Tata McGraw-Hill, Feb-1995.
2. Pneumatic components and circuits by Mujumdar, first edition, Tata McGraw-Hill 1996.
3. Industrial Hydraulics by Pipenger, third Edition, Tata McGraw-Hill 1987.

Reference Books:

1. Process Control and Instrument Technology by C.D.Jhonson, eighth edition, Prentice-Hall of India 2006.
2. Principles of Process Control by D.Patranabis, third Edition, Tata McGraw-Hill 2012.
3. Instrumentation for Process Measurement and Control by N.A.Anderson, third Edition,CRC Press 2000.
4. Control System Engineering by I.J.Nagrath, M.Gopal,Second Edition, Tata McGraw-Hill 2006.
5. Programmable Logic Controllers by JhonWebb,Fifth Edition, PHI,1999.
6. Automatic Control Engineering by Francis Raven, Fifth Edition, McGraw-Hill 2001.
7. Handbook of Instrumentation Engineers (Process Control) Vol.1. by Bela G.Liptak, Fifth Edition.

IN302U MICROCONTROLLER AND APPLICATIONS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

It is an introductory course on microcontrollers with coverage of architecture, hardware interfaces, peripherals, software and description of applications.

COURSE OBJECTIVES:

1. To provide stimulating learning experience while facilitating students to become proficient in designing with 8051.
2. Imparting knowledge about the complete hardware of the microcontrollers and software used to develop programs.

DESIRABLE AWARENESS/SKILLS:

Basic digital circuits design, number system in digital system. Programming in C language,

COURSE OUTCOMES:

CO	After the completion of the course the students will be able to	Blooms Cognitive	
		Level	Descriptor
CO1	Draw and describe architecture of 8051 and peripherals	4	Remembering, understanding
CO2	Write assembly language program for microcontrollers.	3,4	Apply, analyze
CO3	Demonstrate programming skills on embedded C	3,4,5	Apply, analyze
CO4	Interface various peripheral devices to the microcontrollers.	3	Design, Evaluate
CO5	Design microcontroller-based system for various applications	3,4	Design, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	-	2
CO3	2	3	3	3	3	-	-	-	-	-	-	2	3	1	2
CO4	3	3	3	2	2	--	-	-	-	-	-	2	3	2	2
CO5	3	2	2	3	1	1	1	-	-	-	-	2	3	2	3

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

Course Content

Introduction to 8051 Microcontroller

Difference between microprocessor and microcontroller, Architecture of 8051, memory organization and interface, different registers (SFR's) and addressing modes, instruction syntax, data types, subroutines, addressing modes, instruction timings, 8051 instructions.

8051 Programming

Assembly language programs (ALP), Developing, Building, and Debugging ALP's, Concept of assembler directives, editor, linker, debugger, simulator, and emulator. Instruction set, time delay calculations, Introduction to embedded-C, software development tools for 8051, integrated development environment, assembler, simulator and compiler.

8051 Parallel I/O Ports

Basic I/O concepts and I/O programming, port structure and operation, interfacing push buttons, matrix keyboard, seven-segment and LCD displays, interfacing D/A and A/D converter using parallel ports, interfacing serial A/D converter,

8051 Interrupts, Timers/Counters and Serial Communication

8051 Interrupts, interrupt execution sequence, programming with software and hardware interrupts. On-chip Timers, Counters and their operating modes, programming 8051 timers and counters. Basics of serial data communication, 8051 serial communication modes, serial communication programming, Interfacing 8255A with 8051**.**

Interfacing other devices

Stepper motor and DC motor interface, Basic features of RFID, ZIGBEE, GSM/GPS, USB, MMC & SD, Ethernet MAC and their interface with microcontroller. Adding Wi-Fi and Bluetooth capability to the Microcontroller. Introduction to PIC and ARM processors and comparison. Other recent microcontrollers and their applications in process industry.

Text Books:

1. 8051 Microcontroller Hardware, Software and Applications by V. Udayashankara and M. S. Mallikarjunaswamy, Tata McGraw Hill, 2009.
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, second edition, Pearson Education, 2006.

Reference Books:

1. 8051 Microcontroller: Internals, Instructions, Programming and Interfacing by Subrata Ghoshal, second edition, Pearson Education, 2010.
2. 8051 Microcontroller by Sampath K. Venkatesh, published by S. K. Kataria and Sons, 2014.
3. Intel Manual: MCS-51 Architecture.
4. http://www.keil.com
5. NTPL, MOOC courses on this topic.

IN303U SIGNALS AND SYSTEMS

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

Prerequisite: Knowledge of applied mathematics, basic knowledge of differential equations and difference equations.

COURSE DESCRIPTION:

Signals and Systems is an introduction to analog and digital signal processing, a topic that forms an integral part of engineering systems in many diverse areas, including seismic data processing, communications, speech processing, image processing, defense electronics, consumer electronics, and consumer products.

COURSE OBJECTIVES:

The course will provide a strong foundation on signals and systems which will be useful for creating the foundation of signal processing.

1. The students will learn basic continuous time and discrete time signals and systems.
2. Student will understand application of various transforms for analysis of signals and systems both continuous time and discrete time.
3. Students will also explore power and energy signals and spectrum.

COURSE OUTCOMES:

After learning the course the students should be able to:

1. Understand about various types of signals, classify them, analyze them, and perform various operations on them.
2. Understand about various types of systems, classify them, analyze them and understand their response behavior.
3. Appreciate use of transforms in analysis of signals and system.
4. Carry simulation on signals and systems for observing effects of applying various properties and operations.
5. classify random signals using statistical concepts and characterize systems using pseudo-random signals.

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand and remember type of signal	1,2	Remember,Understand
CO2	Concepts of systems and its classification	2,3	Understand,apply
CO3	Concepts of transforms and its applications	2,3,4	Understand,apply,analyze
CO4	Concepts of simulation for systems	3,4,5	apply,analyze,evaluate
CO5	Understand and remember the concepts for signal	1,2	Remember,Understand

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2					1			1					
CO2		1		1	2		1		2			3	2	2	
CO3	1	2							2						
CO4	1			2		1						2		2	
CO5	1		2				2			2	1		2		

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

Course Contents

Classification of Signals and Systems

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_ Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals – Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

Analysis of Continuous time Systems

Fourier series for periodic signals – Fourier Transform(FT) and its properties, Laplace Transforms(LT) and its properties, Laplace Transform as a generalization of the FT. The region of convergence and its properties. Pole-zero plots. Inverse transformation: role of the ROC in ensuring uniqueness. Properties of the LT. Inference of the FT from the LT. System characterization from the pole zero plot. One-sided and two sided LT.

Analysis of Discrete time Systems

Transforms and System frequency response, Realizability of frequency response, Energy spectrum, Calculation of simple transforms, Introduction to Discrete-Fourier transform (DFT), Z-transform, Convergence of Z-transform, Properties of Z Transform, Inversion of Z-transform, Application of Z-transform in analysis of discrete-time systems , Evaluation of discrete-time system frequency response, Inverse systems, Concepts of convolution, Circular convolution, Deconvolution.

Analysis of Systems using Transforms

Impulse response of physical systems – Stability analysis of dynamic systems, convolution and Convolution integral, System impulse response and step response using Laplace/Z-transform, Representation of signals in terms of elementary signals, Condition of orthogonality, Representation of signals by elementary sinusoids.

Statistical Signal Analysis

Classification of random signals, Auto-correlation function, Properties of auto-correlation function, Measurement of auto-correlation function,Application of auto-correlation functions. Cross correlation functions. Sum of random processes. Spectral density, Relation of spectral density to auto-correlation function

System modeling and Analysis by Random signal testing

Auto-correlation function of system output - Cross-correlation between system input and output. White noise - Analysis of linear systems in time-domain using white noise - Mean and mean square value of system output. Generation of pseudo random binary noise (PRBN) and its use in system identification - Analysis in the frequency domain.

Text Books:

1. Gabel R.A. and Robert R.A., Signals and Linear Systems, John Wiley and Sons, 3 rd Edition, 2009
2. Oppenheim A.V., Wilsky and Nawab, Signals and Systems, Prentice Hall, 2nd Edition, 1997. 3. Chen C.T., Systems and Signal Analysis - A Fresh Look, Create Space, 3 rd Edition, 2011

Reference books

1. Cooper G.R and Mc Gillem C.D, Probabilistic Methods of Signals and System Analysis, Oxford University Press, 3 rd Edition, 1999.
2. Chesmond, Wilson and Lepla, Advanced Control System Technology, Viva Books, 1 st Edition, 1998.
3. Ziemer R.E., Tranter W.H., and Fannin D.R., Signals and Systems: Continuous and Discrete, Prentice Hall, 4 th Edition, 1998.

IN304UA POWER ELECTRONICS AND DRIVES
PROFESSIONAL ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course gives opportunity to learn topologies and working principle of various power electronics circuits. It reviews electric drive system, electrical machines, power converters, ac and dc drives used in industries, control circuits and schemes for Industrial drives control.

COURSE OBJECTIVES:

1. Exposure to various topologies, working principle and analysis of controlled rectifiers and ac controllers
2. Detailed knowledge on Classifications, structure, operating principle of dc choppers Introduction to different types of Inverters, their principle of operation and waveform control.
3. Overview on ac and dc drives and their control using power electronic circuits.

COURSE OUTCOMES:

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

1. Classify, analyze and design, Control rectifier, chopper and inverter..
2. Identify salient traits of a virtual instrument and incorporate these traits in their Projects.
3. Apply power electronic circuits for the control of ac and dc drives and applications.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2					1			1					
CO2		1		1	2		1		2			3	2	2	
CO3	1	2							2						
CO4	1			2		1						2		2	
CO5	1		2				2			2	1		2		

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

Course Content

Controlled Rectifiers and AC Controllers

Single phase and Three phase- Half controlled, Fully controlled rectifiers, Dual converters, Effect of source and load inductance, AC voltage controllers, Cycloconverters and Matrix converters.

Dc To Dc Converters

Step up and Step down Chopper- Classification and operation, Switching mode Regulators, Buck, Boost, Buck-Boost and Cuk Regulators.

Dynamics of Electric Drives

Static and Dynamic equations of ac and dc machines- Electrical breaking, Rectifier and chopper control of DC drives, Principles of v/f control of AC drives, Open loop and Closed loop schemes for AC and DC drives

Industrial Drives and Control

Construction working and control scheme- Stepper motor, Servo motor, Solar drive, BLDC drive, PMSM drive, SRM drive and their specific applications.

Text Books:

1. Power Electronics, by Singh, M. D. and Khanchandani, K. B., 2nd Edition, Tata McGraw-Hill, 2011.
2. Power Electronics Circuits, Devices and Applications,by Rashid M. H., PHI, 3rd Edition, 2004.
3. Modern Power Electronics and AC Drives, by Bose, B.K., Pearson Education.

Reference Books:

4. Power Electronics, by P. S. Bhimbra, Khanna Publishers.
5. Power Electronics-Devices, Circuits and Industrial Applications, by Moorthy, V. R. Oxford University Press.
6. Electric Motor Drives: Modeling, Analysis, and Control by R. Krishnan, Prentice Hall.

IN304UB POWER PLANT INSTRUMENTATION
PROFESSIONAL ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

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. Study of Instrumentation and Control Systems used in various power plants
2. Understand various standards and protocols used in different power plants
3. Discuss state of art technologies used in power sector

COURSE OUTCOMES:

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

1. Understanding of Instrumentation used in power plant.
2. Ability to demonstrate the standards used in power plants.
3 Understanding the impact of power plant operation in environmental and societal context

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2					1			1					
CO2		1		1	2		1		2			3	2	2	
CO3	1	2							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

Boiler Ancillaries

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 Control

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

Reference Books:

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

IN304UC BIOMEDICAL ENGINEERING
PROFESSIONAL ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course includes introduction to Biomedical Engineering. This course is designed to introduce the basic anatomy, physiology of Human Body. It includes basic knowledge of electrode systems for measurement of biomedical signals, Introduction of the cardiovascular system, nervous system and neuromuscular systems, Engineering principles, Instrumentation associated with these body systems.

COURSE OBJECTIVES:

1. To Introduce the Mechanisms, Anatomy and Physiology of Human body systems
2. To give the knowledge of engineering principles applied to biomedical systems
3. To give the knowledge of the bio potentials, bioelectric signals and electrode systems
4. To study the characteristics of the ECG, EMG, EEG Waveforms
5. To Introduce on electrical parameters measurement, Safety aspects in BME, Imaging techniques CT, MRI.

COURSE OUTCOMES

After successful completion of this course, students will be able

1. Explain the Anatomical Structure & the basic Physiological functions of various organs within the Human Body.
2. Illustrate the sources of biopotential within human body and measurement of these biopotential using Electrodes
3. Demonstrate the Characteristics of ECG EMG EEG Waveforms
4. To demonstrate the knowledge of non electrical parameter measurements and application of imaging in BME
5. Devise the safety requirements in Bio Medical Equipment design
6.

RELEVANCE OF PO'S AND STRENGTH OF CORRELATION

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
CO2	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
CO3	2	2	-	1	1	-	-	-	-	-	-	-	1	3	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	1	3	1
CO5	3	-	-	-	1	-		2	-	-	-	-	1	3	2

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

Course Contents

Introduction: Biomedical Instrumentation system, classification of biomedical Instruments, Scope for Biomedical Engineers.

Physiology and Biopotential Electrodes: Physiology of cardiovascular system, respiratory system, nervous system, Resting and Action Potential, Electrode electrolyte interface, half-cell potential, Electrodes Limb electrodes, floating electrodes, pregelled disposable electrodes, needle and surface electrodes

Electrical activity of the Heart: Conducting system of the heart,ECG leads Measurement and analysis of EGG waveform. Block schematic of ECG system, Introduction of defibrillators.

Electrical activity of the Brain: Sources of brain potential, generation of brain signals, EEG component waves, EEG -10-20 electrode system, Block schematic of EEG system

Electrical activity of the Muscular system: muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, Block schematic of EMG system

Introduction to Non-Electrical Parameter Measurements: Measurement of blood pressure, pulmonary function measurements, Blood Gas analyzers,

Introduction to Imaging systems – Introduction of Computer tomography, Magnetic resonance imaging system and applications in biomedical engineering

Safety aspects in biomedical engineering, Ground loops ,ground currents,shielding,Saftey of biomedical equipments

Text Books:

1. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, India, 2003.
2. Biomedical Instrumentation and measurement, Leslie Cromwell, 3rd edition, Prentice Hall of India, New Delhi, 1997.

Reference Books:

1. Biomedical Instrumentation, Webster J. G., 4th edition, John Wiley and Sons, Hoboken, NJ, 2004.
2. Introduction to Biomedical Equipment Technology, Carr J., and Brown J., 4th edition, Pearson Education, 2000.
3. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000

IN304UD NAVIGATIONAL INSTRUMENTATION
PROFESSIONAL ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course introduces the concepts and applications of navigation techniques using celestial bodies and satellite positioning systems such as the Global Positioning System (GPS). Topics include astronomical observations, radio navigation systems, the relationship between conventional navigation results and those obtained from GPS, and the effects of the security systems, Selective Availability, and anti-spoofing on GPS results.

DESIRABLE AWARENESS:

Vehicle modeling, measuring instruments and communication techniques.

COURSE OBJECTIVES:

The objectives of offering this course are to-

1. Introduce the basic knowledge of navigational instrumentation and their techniques
2. Understanding of navigation designing tools if any, and familiarizes the practical systems.
3. Participate in the design of systems that act intelligently and learn from experience.
4. Develop ability to understand the concept and solution of the challenges in navigation field.

COURSE OUTCOMES:

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

1. Acquainted with the system architecture of navigational methods and instruments.
2. Select appropriate navigation technique for a given real world path planning problem.
3. Develop GPS/INS data algorithm for integration of navigation techniques.
4. Apply the principles of routing and guidance in navigation of vehicle with their accuracy measures.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	-	-	-	2	2	-
CO2	2	2	1	1	2	1	-	-	-	-	-	-	3	1	-
CO3	2	1	2	1	1	1	-	-	-	-	-	-	2	1	1
CO4	2	1	1	1	1	-	-	-	-	-	-	-	2	1	1

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

Course Content:

Navigation: Introduction to navigation, Origins of navigation, Mathematical fundamentals: Reference frames, Principles of position determination, velocity determination, attitude determination, Principles of routing and guidance, Accuracy measures, Navigable maps and requirements.

Terrestrial navigation: Introduction, Instruments and observables, vehicle modeling, Position determination technique, beacon-based navigation systems, Terrestrial radio navigation, Point source systems, Area-based systems, Aircraft landing systems.

Celestial navigation: Introduction, Astronomical basics: Coordinate systems, Time Systems, Celestial fix by spherical resection, Star tracker, Internet sources on celestial navigation. Satellite-based navigation : Introduction, Global Positioning System (GPS) , Global Navigation Satellite System (GLONASS), Galileo and Other satellite-based navigation systems: Basic concept, System architecture, Satellite signal and observables, System services.

Inertial Navigation System: Introduction to Inertial Sensors and Inertial Navigation, Principle of Inertial Navigation , Physical Implementation of an INS, Inertial Measurement Unit, Inertial Sensors, Basics of Inertial Navigation, Navigation in Three Dimensions, Navigation in Three Dimensions, Overview of an Inertial Navigation System in 3D, Theoretical Measurements of the Inertial Sensor, Notes on Inertial Sensor Measurements, Inertial Sensor Performance Characteristics, Inertial Sensor Errors, Classification of Inertial Sensors, Calibration of Inertial Sensors, Importance of Calibration of Inertial Sensors, Initialization and Alignment of Inertial Sensors.

INS/GPS Integration: Error Feedback Schemes, open loop and close loop INS/GPS Architecture, Types of Integration: loosely coupled, tightly coupled, ultra tightly coupled, Dynamic Error Model of INS Equations, Models for Loosely Coupled INS/GPS Integration, Modeling Tightly Coupled INS/GPS Integration, GPS /INS data fusion algorithms.

Text books:

1. Elements of electronic navigation by Nagaraja.M.S, 3rd edition, Tata McGraw Hill, 2002
2. Aircraft instruments- Principles and applications by Pallet.E.H.J , 2nd edition, Pearson Publication, 2001
3. Measurement Systems-Application and Design by Ernest O Doebelin, Dhanesh N Manik, 5th Edition, Tata McGraw Hill, 2007.

Reference books:

1. Navigation: Principles of Positioning and Guidance by Bernhard Hofmann-Wellenhof, Klaus Legat and Manfred Wieser, 1st edition, Springer, 2003.
2. Fundamentals of Inertial Navigation, Satellite-based Positioning and their Integration by Aboelmagd Noureldin, Tashfeen B. Karamat, Jacques Georgy, 1st edition, Springer, 2013,
3. Onertial Navigation analysis and design by Slater J.M., Donnel C.F.O, 2nd edition, McGraw Hill, New York, 1998.
4. Avionics Navigation systems, Myron Kyton, Walfred Fried, 2nd edition, John Willy & Sons, 1999.
5. Modern Aviation Electronics by Albert D Helfrick, 3rd edition, PHI, 2001.
6. Spacecraft Dynamics and Control-A Practical Engineering Approach by Marcel J. Sidi , 1st Edition, Cambridge University Press, 1997.

IN305UA VIRTUAL INSTRUMENTATION
OPEN ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

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. Designing of applications for real time systems in biomedical signal acquisition and processing, Measurement and control of physical and chemical parameters, Industrial automation system development.

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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	-	-	-	2	2	-
CO2	2	2	1	1	2	1	-	-	-	-	-	-	3	1	-
CO3	2	1	2	1	1	1	-	-	-	-	-	-	2	1	1
CO4	2	1	1	1	1	-	-	-	-	-	-	-	2	1	1

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 nodes, local and global variable, string, file handling, states 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 signal and image acquisition and processing. NI ELVIS board. NI virtual bench.

Applications

Use of various hardware tools like DAQ cards, ELVIS board, Virtual bench for design of VI: Application in process control equipment's design, Oscilloscope, Digital Millimeter using Lab view Software, use of VI for data acquisition and control using Lab VIEW for physical parameters like temperature, pressure, flow, level etc. design of automation systems, design real time systems for signal and image acquisition and processing using LabVIEW.

Text Book:

1. Johnson, G., LabVIEW Graphical Programming, McGraw−Hill (2006). 2. Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004). 3. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).
2. Let Us LabVIEW by Nitesh Pradhan

Reference Books:

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

IN305UB NETWORK CONTROL SYSTEM (PLC AND DCS)
OPEN ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The course focuses on programmable logic controller (PLC) and distributed control system (DCS) based industrial Automation systems and Industrial protocol. The course will cover 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.

DESIRABLE AWARENESS:

Logic gates operations, Boolean algebra, signal conditioning and transmission.

COURSE OBJECTIVES:

The objectives of offering this course are to-

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:

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

1. Apply the knowledge of automation in machine and process control.
2. Design and conduct practical in realistic constrain on machines 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 DCS system.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	-	-	2	2	-
CO2	2	2	3	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	2	3	1	-	-	-	-	-	-	-	-	2	2	1
CO4	2	2	2	1	-	-	-	-	-	-	-	-	1	2	1

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

Course Content:

Introduction to PLC: Definition and History of PLC, Overall PLC system, PLC Input & Output modules, central processing unit, CPUs and Programmer/monitors, Solid state memory, the processor, Input modules (Interfaces), Power supplies, PLC advantages & disadvantages. Selection criteria for PLC.

Programming of PLC: Programming equipments, proper construction of PLC ladder diagram, Basic components & their symbols in ladder diagram, Fundamentals of ladder diagram, Boolean logic & relay logic, and analysis of rungs. Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, Output analog devices, programming ON/OFF Inputs to produce ON/OFF outputs.

Advanced PLC Function: Analog PLC operation, PID control of continuous processes, simple closed loop systems, problems with simple closed loop systems, closed loop system using Proportional, Integral and Derivative (PID), PLC interface, and Industrial process example. Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.

Distributed Control System: DCS – 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, attributes of DCS, flow sheet symbols, DCS system integration, I/O hardware stations, set-point station control, supervisory computer tasks and 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: Evolution of signal standard, Overview of Open systems interconnection (OSI) Model, Functions of OSI Model Layers, OSI Protocols, Functions of Transmission control protocol / Internet protocol (TCP/IP) Layers, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), DeviceNet, ControlNet, EtherNet/IP, Flexible Function Block process (FFB), Process Field bus (Profibus), The Security Implications of the SCADA 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. Computer-based Industrial Controls by Krishan Kant, 2nd edition, PHI India, New Delhi, 2004.
2. Computer Control of Process by M. Chidambaram, 1st edition, Narosha Publishing. 2005.
3. Introduction to Programmable controller by Garry Dunning, 2nd Edition, Thomson Asia, Pte, Ltd, Singapore, 2002.
4. Programmable Logic Controllers Programming Methods and Applications by John R. Hackworth, Frederick D., Hackworth Jr., 3rd edition, Pearson Education, 2005.
5. Programmable Logic Controllers with Applications by P. K. Srivstava, BPB Publications, 1st edition, 2001.

Reference books:

1. Distributed Computer Control for Industrial Automation by D. Popovic and Vijay Bhatkar, 1st edition, Marcel Dekker Inc., 1998.
2. Programmable Logic Controllers: Principles and Application by John W. Webb, Ronald A. Reis, 5th Edition, McGraw Hill Inc., 2006.
3. Securing SCADA System by Ronald L. Krutz, 1st edition, Wiley Publishing, 2007 SCADA: supervisory control and data acquisition by Stuart A Boyer, 4th edition, ISA Publishing, 2010.
4. Programmable Controllers by Batten G. L., 2ndEdition, McGraw Hill Inc., 2004.
5. Instruments Engineers Handbook Process Control ,VoL-II by Bela G. Liptak, CRC Press, 4th edition, 2006.

IN305UC INTRODUCTION TO BIOMEDICAL ENGINEERING
OPEN ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course includes introduction to the Biomedical Engineering. This course is designed to introduce the basic anatomy, physiology of Human Body. It includes basic knowledge of electrode systems for measurement of biomedical signals, Introduction of the cardiovascular system, nervous system and neuromuscular systems, Engineering principles, Instrumentation associated with these body systems. The course is designed in view of interdisciplinary programs and students can study the subject as per scope of their program/branch specific applications .

COURSE OBJECTIVES:

1. To Introduce the Mechanisms, Anatomy and Physiology of Human body systems
2. To give the knowledge of engineering principles applied to biomedical systems
3. To give the knowledge of the bio potentials, bioelectric signals and electrode systems
4. To study the characteristics of the ECG, EMG, EEG Waveforms
5. To Introduce non electrical parameters measurement, Safety aspects in BME, Imaging techniques CT, MRI.
6. Students can study the subject as per scope of their program /Branch specific applications.

COURSE OUTCOMES

After successful completion of this course, students will be able to

1. Explain the Anatomical Structure & the basic Physiological functions of various organs within the Human Body.
2. Illustrate the sources of biopotential within human body and measurement of these biopotential using Electrodes
3. Demonstrate the measurements on and interpretation of data from ECG, EMG, EEG waveform, non-electrical parameter measurements, safety in BME
4. Devise the safety requirements in Bio Medical Equipment design
5. Work in interdisciplinary team as per scope of their respective program /branch specific applications in Biomedical Engineering

RELEVANCE OF PO'S AND STRENGTH OF CORRELATION

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
CO2	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1

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

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

Course Contents

Introduction: Biomedical Instrumentation system, classification of biomedical Instruments, Scope for Biomedical Engineers.

Physiology and Biopotential Electrodes: Physiology of cardiovascular system, respiratory system, nervous system, Resting and Action Potential, Electrode electrolyte interface, half-cell potential, Electrodes used for measurement of biomedical signals

Electrical activity of the Heart: Conducting system of the heart,ECG leads Measurement and analysis of EGG waveform. Block schematic of ECG system, Introduction of defibrillators.

Electrical activity of the Brain: Sources of brain potential, generation of brain signals, EEG component waves, EEG -10-20 electrode system, Block schematic of EEG system

Electrical activity of the Muscular system: muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, Block schematic of EMG system

Introduction to Non-Electrical Parameter Measurements and Safety aspects in BME: Measurement of blood pressure, pulmonary function measurements, Blood Gas analyzers, Safety aspects in biomedical engineering

Introduction to Imaging systems – Introduction, Basic concepts of Computer tomography, Magnetic resonance imaging system, ultrasound Imaging techniques. Applications of biomedical engineering in interdisciplinary fields

Text Books:

1. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, India, 2003.
2. Biomedical Instrumentation and measurement, Leslie Cromwell, 3rd edition, Prentice Hall of India, New Delhi, 1997.

Reference Books:

1. Biomedical Instrumentation, Webster J. G., 4th edition, John Wiley and Sons, Hoboken, NJ, 2004.
2. Introduction to Biomedical Equipment Technology, Carr J., and Brown J., 4th edition, Pearson Education, 2000.
3. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000

IN305UD OPERATIONS RESEARCH
OPEN ELECTIVE-I

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Optimization is the most important sub area of the discipline Operations Research. Optimization problems arise in all walks of human activity- particularly in Engineering, Business, Finance and Economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically model real life optimization problems as Linear Programming (Optimization) Problems and subsequently educate the student to solve these models with the help of the available methods.

COURSE OBJECTIVES:

1. To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
2. To familiarize the students with various tools of optimization, probability, statistics and simulation, as applicable in particular scenarios in industry for better management of various resources.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Illustrate the need to optimally utilize the resources in various types of industries.	01,02	Remembering, Understanding
CO2	Apply and analyze mathematical optimization functions to various applications.	01,02	Applying
CO3	Demonstrate cost effective strategies in various applications in industry.	03	Applying

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1

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

Course Content

Introduction: Operation Research

Introduction: Definition, Evolution and Classification of Quantitative Methods and Operations Research Techniques, Methodology, Advantages and Limitations. Linear Programming: Introduction, Formulation, Simplex Method (Big – M and Two Phase Methods), Dual Simplex Method (Conversion of primal to dual) Introduction to Sensitivity Analysis. Decision Theory: Meaning and Steps in Decision Making, Types of Management Decisions, Decision under Certainty, under Risk, under Uncertainty, Decision Trees.

Transportation Model

Introduction, Formulation, Basic Method of Solving Transportation Problem, Optimization Methods like UV and Stepping Stone Method, Concept of Trans-shipment Methods as an Extension of Transportation. Assignment Problem- Hungarian Method to solve Assignment Problem, Travelling Salesman as an Extension of Assignment Problem.

Theory of Games and Investment Analysis

Theory of Games : Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance, Solution by Graphical Method, m x n size Game Problem, Iterative method, Introduction to formulation of games using Linear Programming. Investment Analysis: Break-Even Analysis, Payback Period Method, A (A) R Method, DCF Method, IRR Method, Introduction to Probabilistic Models.

Inventory Control and Replacement Analysis

Inventory Control - Deterministic Models- Shortage, without shortage; Probabilistic Inventory Models, Introduction to Concept of Service level. Replacement Analysis - Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly.

Queuing Theory and Sequencing models

Queuing Theory - Introduction, Basis Structure, Terminology (Kendal‘s Notations) and Applications. Queuing Model M/M/1: /FIFO, M/M/c

Text Books:

1. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
2. J. K. Sharma, Operations Research : Theory And Application, Laxmi pub. India.
3. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut.

Reference Books:

1. Belegundu, ― Optimization Concepts and Applications in engineering, Cambridge Uni. Press, India
2. Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India

3. Ravindran, ―Engineering optimization Methods and Appliations‖, 2nd edition, Wiley, India
4. Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey,
5. Operations Research - An introduction, Hamdy A Taha, Pearson Education. Jiri Marek,Hans Peter trah ,"Sensors applications, sensors for automotive Technology"
1st Edition.

IN306U CONTROL SYSTEM COMPONENTS LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION: This lab course provides the knowledge of various control components and controllers used for Industrial control systems. This course provides knowledge about different control system components like various types of transmitters and converters. It gives brief introduction to control valves and the study of various control modes controllers like PID.

COURSE OBJECTIVES:

1. To understand the basic principle of control system components of different systems.
2. To understand the basic principle of controllers.
3. The objective of the course is to provide students with a firm grasp of the essential principles of control system components.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Acquire the knowledge of system of units, classification and essentials of measuring instruments.	01,02	Remembering, Understanding
CO2	Design the construction and operation of various measuring instruments.	01,02	Remembering, Understanding
CO3	Identify the measuring instruments and apply them for quantifying measurements of parameters.	02	Understanding
CO4	Analyse and select proper instrument for given application	03	Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2

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

LIST OF EXPERIMENT:

Minimum Ten experiments shall be performed to cover entire curriculum of course IN302. The list given below is just a guideline.

1. Study of pneumatic components and simple pneumatic circuits.
2. Study of hydraulic components and simple hydraulic circuits.
3. To plot the characteristics of two-wire transmitter.
4. To plot the characteristics of I/P or P/I converter.
5. Calibration of DP transmitter for flow/ level interface.
6. Tuning of PID controller.
7. Study of actuators.
8. To plot the characteristics of control valve.
9. Implement various ISA sequence on alarm annunciator.
10. To plot the characteristics of synchros.
11. To plot the characteristics of square root extractor.
12. Study of Pressure switch / Temperature switch.

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.
- **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.

IN307U MICROCONTROLLER AND APPLICATIONS LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course covers various aspects of 8051C and assembly language programming and interfacing. Examples and programs will be covered to clarify the concepts and provide students an opportunity to learn by performance. This course provides the base by which the design and interfacing of microcontroller based embedded systems can be explored.

COURSE OBJECTIVES:

1. To provide stimulating learning experience while facilitating students to become proficient in designing with 8051.
2. Imparting knowledge about the complete hardware of the microcontrollers and software used to develop programs.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Identify and describe architecture of 8051 and peripherals.	4	Remembering, understanding
CO2	Write assembly language program for microcontrollers.	3,4	Apply, analyze
CO3	demonstrate programming skills on embedded C	3,4,5	Apply, analyze
CO4	Interface various peripheral devices to the microcontrollers.	3	Design, Evaluate
CO5	Design microcontroller-based system for various applications	3,4	Design, Evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	-	2
CO3	2	3	3	3	3	-	-	-	-	-	-	2	3	1	2
CO4	3	3	3	2	2	--	-	-	-	-	-	2	3	2	2
CO5	3	2	2	3	1	1	1	-	-	-	-	2	3	2	3

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

Minimum Ten experiments (3Assembly, 3 C program, 4 interfacing) shall be performed to cover entire curriculum of course IN302U. The list given below is just a guideline.

LIST OF EXPERIMENT:

1. Introduction to Microcontroller 8051 Instruction set.
2. Write a 8051 assembly language program for multiplication / division of two 8-bit numbers.
3. Write a 8051 ALP to find smallest / largest number from a given array.
4. Write a 8051 ALP to find number from a given array.
5. Write a 8051 ALP to transfer the block of memory contents from one to another memory location in same/ reverse direction..
6. Write a 8051 ALP to arrange the numbers in ascending/ descending order.
7. Write a 8051 ALP to add/subtract two numbers and display on LCD display.
8. Introduction to software development tools: SC51 compiler.
9. Write a C program to turn on the buzzer/glow LED through 8051 I/O ports.
10. Introduction to software development tools: Micro-vision C compiler and simulator.
12. Write a C program to send a message on serial port and simulate the same in Micro-vision C compiler and simulator.
13. Write a C program to turn on the port LEDs based on key input from port pushbuttons.
14. Write a C program for communication between PC and 8051 μc through serial port.
15. Write a program to generate two square waves – one of 5 KHz frequency at pin P1.3 and another of frequency 25 KHz at pin P2.3. Assume XTAL=22 MHz.
16. Write a 8051 C program to send letters to LCD using delays.
17. Write a Program to control the speed of DC motor.
18.. Write a program to control the speed of stepper motor.
19. Other interfacing programs, as available in lab.

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 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.

IN308U VIRTUAL INSTRUMENTATION LAB

Teaching Scheme: 01L + 02 P; Total: 03 **Credits:** 02
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

In this laboratory, course emphasis on imparting the hands on, practical knowledge and understanding of basics of graphical and dataflow programming methods, learning of NI LabVIEW software, use of various tools in software for developing a VI, study of different hardware available in laboratory for interfacing real data signal to LabVIEW, design real time systems for measurement and control and biomedical signal processing.

COURSE OBJECTIVES:

1. Understand graphical programming using LabVIEW.
2. Design virtual instruments using LabVIEW.
3. Acquire knowledge on how virtual instrumentation can be applied for data acquisition and instrument control.
4. Case Study of Labview Projects such as biomedical signal acquisition and processing, Temperature measurement and control, Level control etc.

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. experiment, analyze and document in the laboratory prototype measurement Systems using a computer, plug-in DAQ interfaces and bench level instrument.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	-	2
CO3	2	3	3	3	3	-	-	-	-	-	-	2	3	1	2

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

LIST OF EXPERIMENT:

Minimum ten experiments shall be performed. The list given below is just a guideline.

Introduction to virtual instrumentation, need of VI, advantages of VI, define VI, block diagram & architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming, LabVIEW software, study of data acquisition & control using LabVIEW software and hardware.

Teacher should facilitate learning following lab experiments:

1. To study programming for virtual instrument using LabVIEW.
2. Develop a LabVIEW program for conversion of
   - degree celsius to fahrenheit
   - degree celsius to kelvin
   - degree celsius to rankin
3. Implementation of full adder using LabVIEW.
4. To generate 'n' random number using for loop and plot it.
5. To develop a LabView program for creating function generator for variable with variable amplitude, frequency and phase.
6. To Develop a LabView program for addition of
   - Array with Array
   - Array with Number
   - Cluster with Number
7. Develop a LabVIEW program for addition of matrix with matrix and waveform with number.
8. Develop a LabView program for demonstration using case structure and sequence structure.
9. Develop a LabVIEW program for Amplitude, Phase and Frequency measurement.
10. To Integrate and use Hardware compatible with LabVIEW like DAQ Cards, NI ELVIS board.
11. Develop a LabVIEW based temperature measurement and control System.
12. Demonstrate five integrated virtual instruments using NI Virtual bench.
13. Demonstrate of 12 integrated virtual instrument using NI ELVIS2.
14. Analog and Digital I/O handling using NI DAQ6009.
15. Demonstrate of NI ELVIS2 based Mechatronics sensor board.

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 **.**
- **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.

IN309UA POWER ELECTRONICS AND DRIVES LAB
PROFESSIONAL ELECTIVE-I LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

In this laboratory, course emphasis on imparting the hands on, practical knowledge and understanding of basics of Working, Characteristics and Computer Aided Simulation of Electrical AC and DC Machines.

COURSE OBJECTIVES:

1. To make the students aware of different power conversion techniques.
2. To understand the various control methods for machines

COURSE OUTCOMES:

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

1. to design single phase and three phase power electronics circuits and their applications.
2. identify salient traits of control schemes for drives and incorporate these traits in their Projects.
3. experiment, analyze and document in the laboratory using computer simulation for industrial drives simulation and control.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	-	2
CO3	2	3	3	3	3	-	-	-	-	-	-	2	3	1	2
CO4	3	3	3	2	2	--	-	-	-	-	-	2	3	2	2
CO5	3	2	2	3	1	1	1	-	-	-	-	2	3	2	3

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

LIST OF EXPERIMENT:

Minimum eight experiments shall be performed. The list given below is just a guideline.
It includes plotting characteristics and control scheme design for ac and dc drives using power electronic converters and circuits. MATLAB/SIMULINK development and simulation of converters, inverters, ac-voltage controllers, implementation of various control techniques for drives.

Teacher should facilitate for learning following lab experiments:

1. To design AC-DC converters and implement a control.
2. To design DC-AC converters and implement a control.
3. To design DC-DC converters and implement a control.
4. To design AC to AC converters and their controllers.
5. To plot characteristics of Permanent magnet Synchronous motor.
6. To plot characteristics of Stepper motor
7. To plot characteristics of SRM drive.
8. To plot characteristics of BLDC drive.
9. Computer simulation for control of various ac and dc drives in curriculum

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.
- **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.

IN309UB POWER PLANT INSTRUMENTATION LAB
PROFESSIONAL ELECTIVE-I LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

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.

COURSE OBJECTIVES:

1. Study of Instrumentation and Control Systems used in various power plants
2. Understand various standards and protocols used in different power plants
3. Discuss state of art technologies used in power sector

COURSE OUTCOMES:

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

1. Understanding of Instrumentation used in power plant.
2. Ability to demonstrate the standards used in power plants.
3. Understanding the impact of power plant operation in environmental and societal context

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2					1			1					
CO2		1		1	2		1		2			3	2	2	
CO3	1	2							2						

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

LIST OF EXPERIMENT:

Minimum Ten experiments shall be performed to cover entire curriculum of course IN304UB. 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.

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

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.
- **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

IN309UC BIOMEDICAL ENGINEERING LAB
PROFESSIONAL ELECTIVE-I LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course includes introduction to Biomedical Engineering. This course is designed to introduce the basic anatomy, physiology of Human Body. It includes basic knowledge of electrode systems for measurement of biomedical signals, Introduction of the cardiovascular system, nervous system and neuromuscular systems, Engineering principles, Instrumentation associated with these body systems.

COURSE OBJECTIVES:

1. To Introduce the Mechanisms, Anatomy and Physiology of Human body systems
2. To give the knowledge of engineering principles applied to biomedical systems
3. To give the knowledge of the bio potentials, bioelectric signals and electrode systems
4. To study the characteristics of the ECG, EMG, EEG Waveforms
5. To Introduce on electrical parameters measurement, Safety aspects in BME, Imaging techniques CT, MRI.

COURSE OUTCOMES

After successful completion of this course, students will be able

1. Explain the Anatomical Structure & the basic Physiological functions of various organs within the Human Body.
2. Illustrate the sources of biopotential within human body and measurement of these biopotential using Electrodes
3. Demonstrate the Characteristics of ECG EMG EEG Waveforms
4. To demonstrate the knowledge of non-electrical parameter measurements and application of imaging in BME
5. Devise the safety requirements in Bio Medical Equipment design

RELEVANCE OF PO'S AND STRENGTH OF CORRELATION

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
CO2	3	1	-	-	-	-	-	-	-	-	-	-	1	3	1
CO3	2	2	-	1	1	-	-	-	-	-	-	-	1	3	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	1	3	1
CO5	3	-	-	-	1	-		2	-	-	-	-	1	3	2

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

LIST OF EXPERIMENTS

Minimum eight experiments should be conducted from the sample list given below

1. To Study, Observe and categorize different types of ECG, EMG,EEG electrodes
2. Measurement of Heart Rate by using Stethoscope
3. Calculation and Classification of BMI Index as per standard chart
4. Measurement and Monitoring of Blood Pressure by using Sphygmomanometer
5. Measurement and Monitoring of percentage of SPO2 by using Pulse Oxymeter
6. Measurement and analysis of Real Time ECG by using ECG Machine.
7. Monitoring of Normal ECG and Heart rate calculation from ECG signals
8. Monitoring of Pulse rate by using Digital Storage Oscilloscope
9. Demonstration and Study of Bed Side Monitor
10. To study the different waveforms of EEG with respect to frequency and amplitude
11. To Study & Analyze Electrical safety considerations for Biomedical Instruments
12. To study and measure electrical energy in DC Defibrillator

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.
- **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.

IN309UD NAVIGATIONAL INSTRUMENTATION LAB
PROFESSIONAL ELECTIVE-I LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course introduces the concepts and applications of navigation techniques using celestial bodies and satellite positioning systems such as the Global Positioning System (GPS). Topics include astronomical observations, radio navigation systems, the relationship between conventional navigation results and those obtained from GPS, and the effects of the security systems, Selective Availability, and anti-spoofing on GPS results.

DESIRABLE AWARENESS:

Vehicle modeling, measuring instruments and communication techniques.

COURSE OBJECTIVES:

The objectives of offering this course are to-

5. Introduce the basic knowledge of navigational instrumentation and their techniques
6. Understanding of navigation designing tools if any, and familiarizes the practical systems.
7. Participate in the design of systems that act intelligently and learn from experience.
8. Develop ability to understand the concept and solution of the challenges in navigation field.

COURSE OUTCOMES:

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

5. Acquainted with the system architecture of navigational methods and instruments.
6. Select appropriate navigation technique for a given real world path planning problem.
7. Develop GPS/INS data algorithm for integration of navigation techniques.
8. Apply the principles of routing and guidance in navigation of vehicle with their accuracy measures.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	-	-	-	2	2	-
CO2	2	2	1	1	2	1	-	-	-	-	-	-	3	1	-
CO3	2	1	2	1	1	1	-	-	-	-	-	-	2	1	1
CO4	2	1	1	1	1	-	-	-	-	-	-	-	2	1	1

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

LIST OF EXPERIMENTS

1. Initialization and Calibration of accelerometers and gyroscopes in navigation system.
2. Perform navigation system level tests such as rate test, multi-position test and all attitude test.
3. Determine velocity response and perform operation on 2-axis Angular Motion Simulation set up.
4. Motion planning of mobile robot using Rapidly-Exploring Random Tree algorithm.
5. Determine response of navigational sensor model such IMU, INS and GPS using MATLAB.
6. Estimate position and localization of ground vehicle using MATLAB.
7. Development of data fusion algorithm for integration of GPS/INS navigation techniques
8. Study of loosely coupled, tightly coupled, ultra-tightly coupled GPS/INS integration model.
9. Implement Simultaneous Localization and Mapping with lidar scans using pose graph optimization.
10. Develop trajectory and waypoint following algorithms using MATLAB.

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.

- **ESE –** The end semester examination (ESE) for this laboratory course shall be based on oral examination 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.

IN310U INDUSTRIAL VISIT/ENTERPREUNERSHIP DEVELOPMENT PROGRAM (EDP)/CASE STUDIES

Teaching Scheme: 01L + 02 P; Total: 03 **Credits:** 02
Evaluation Scheme: 50 ICA **Total Marks:** 50
ESE Duration: 00 Hrs

COURSE DESCRIPTION:

Entrepreneurship Development Programs helps students interested in the entrepreneurial environment to help develop their ideas into a successful business. This program provides them with the necessary skills and tools to enable success through classroom training and exposure to insights from actual entrepreneurs. This is essential if students want to make their presence felt in a competitive market.

COURSE OBJECTIVES:

The course will provide an interaction with industry which will be useful for creating the carrer to the students. After g

1. for employment in the core industrial/manufacturing sector
2. for employment in research and development organizations
3. for employment in automation & IT/ITES industry
4. for graduate studies in engineering and management
5. for entrepreneurship in the long run

COURSE OUTCOMES:

After 4 years of study and industry training/visits, the students should be able to:

1. would be thoroughly prepared and confident to take up complex problems in the field of I & C and provide sustainable solutions by (i) surveying the literature and patents, (ii) designing and conducting experiments, (iii) interpreting the data, (iv) drawing relevant conclusions, with due consideration and responsibility towards the immediate social, cultural, environmental and legal issues, and (v) documenting the research carried out,
2. would be able to evaluate and deliver the solutions by optimally utilizing the available resources, including finances and project time, by adapting appropriate resource management techniques,
3. would be competent to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
4. would be proficient in English language (spoken and written) in order to communicate effectively on complex engineering activities on a global scale, make comprehensive reports and presentations, and give and receive clear instructions,

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Understand the role of engineer	3	Apply
CO2	Solutions to problems	2,3	Understand,apply
CO3	knowledge to assess societal, health, safety, legal and cultural issues	2,3,4	Understand,apply,analyze
CO4	communication and presentation skils	3,5	apply,evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2					1			1					
CO2		1		1	2		1		2			3	2	2	
CO3	1	2							2						
CO4	1			2		1						2		2	

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

Course Contents

It is expected that the students should be familiar with the industrial environment. It is recommended to complete training in industry as per policy of AICTE/institute. The students are recommended to complete need based training/visit/interaction with industry to improve considering following aspects:

- Constant interaction with real stakeholders in real-time;
- First-hand experience working as an engineering professional
- Working in interdisciplinary, in real and virtual environs;
- Apply your technical knowledge and engineering methods to a real-life situations
- Experience what it's like to work in a professional organisation
- Learning abroad in a multicultural environment;
- Knowledge transfer in daily mentoring by top experts;
- Increase your technical, interpersonal and communication skills, both oral and written
- Gamifying the learning experience;
- Learning together with entrepreneurs;
- Imposed creativity for excellent time and resources management;
- Creating and exploiting an invaluable network of like-minded ambitious talents.
- Work with other engineering professionals
- Observe interactions of engineers with other professional groups
- Witness the functioning and organisation of business and companies

The students are also directed and guided for

- to assess and analyses entrepreneurship as a career choice,
- efficiently work in a complex environment of multi-cultural teams made up of interdisciplinary physical and virtual member profiles,
- develop a business idea into a comprehensive and highly scalable business model by applying customer development principles in a real-life exercise,
- design a successful commercialization strategy for their product or service, launch their product or service to the market fast and acquire customers

IN453UA EMBEDDED SYSTEM
PROFESSIONAL ELECTIVE-V

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

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:

1. Student can improve 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..
2. Imparting knowledge about the fundamental aspects that form the basis of hardware and software designing of embedded systems.

COURSE OUTCOMES:

CO	After the completion of the course the students will be able to	Blooms Cognitive	
		Level	Descriptor
CO1	Acquire the knowledge of the fundamental aspects that form the basis of hardware and software designing of embedded systems.	4	Remembering, understanding
CO2	Learn embedded system with real word applications.	3,4	
CO3	Understand embedded hardware architecture, interfacing techniques, buses and protocols, hardware and software interrupts.	3,4,5	
CO4	Experiment with Embedded software programming tools and model, simulation and debug the embedded model inter-process synchronization and real time operating system	3	
CO5	Design real time embedded systems using the concept of RTOS.	3,4	Apply, Creat

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2	3	3	3	3									3		2
CO3	2	3	3	3	1								3	1	2
CO4	3	3	3	2									3	1	2
CO5	3	2	2	1									2	1	2

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 'C',Embedded 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, Tata McGraw-Hill Education, 2011
2. Fundamentals of Embedded software, Daniel W. Lewis, Prentice Hall of India, 2013.

Reference Books

1. An Embedded software primer, David E. Simon, Pearson Education, 2005
2. Embedded System Design – 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, 2nd edition, Newnes, 2003.

IN453UB FIBER OPTICS AND LASER
PROFESSIONAL ELECTIVE-V

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

To contribute to the knowledge of Fiber optics and Laser Instrumentation and its Industrial and Medical Applications.

COURSE OBJECTIVES:

1 To understand the basic concepts of optical fibers and their properties
2 To provide adequate knowledge about the Industrial applications of optical fibers
3 To understand the Laser fundamentals and Industrial application of lasers.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Acquire the knowledge of system of units, classification and essentials of measuring instruments.	01,02	Remembering, Understanding
CO2	Design the construction and operation of various measuring instruments.	01,02	Remembering, Understanding
CO3	Identify the measuring instruments and apply them for quantifying measurements of parameters.	02	Understanding
CO4	Analyse and select proper instrument for given application	03	Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2

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,LED's.

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.

References:

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

IN453UC ARTIFICIAL INTELLIGENCE
PROFESSIONAL ELECTIVE-V

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course introduce the student to artificial intelligence (AI) as a multidisciplinary field that requires a range of skills in statistics, mathematics, predictive modeling, analysis and their applications in engineering.

DESIRABLE AWARENESS:

Calculus, Linear Algebra, Statistics and Predominant Programming Language.

COURSE OBJECTIVES:

The objectives of offering this course are to-

1. Provide the most fundamental knowledge to the students so that they can understand AI.
2. Identify problems where artificial intelligence techniques are applicable.
3. Participate in the design of systems that act intelligently and learn from experience.

COURSE OUTCOMES:

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

1. Acquainted with the expert system architecture and artificial intelligence
2. Select appropriate AI technique for a given real world problem
3. Develop neural network, fuzzy logic, genetic algorithm and hybrid system for control system applications
4. Understand the basics of learning and training algorithms
5. Apply the principles of machine learning and AI for practical applications.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	-	-	-	1	2	-
CO2	2	3	2	1	2	1	-	-	-	-	-	-	3	1	-
CO3	3	2	2	1	3	1	-	-	-	-	-	-	2	2	1
CO4	2	2	1	1	1	-	-	-	-	-	-	-	2	2	1
CO5	3	2	2	1	-	-	-	-	-	-	-	-	3	2	1

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

Course Content:

Introduction to Artificial Intelligence and Expert systems: The concept and importance of Artificial Intelligence (AI), Course structure and policies, History of AI, Proposing and evaluating AI applications, Case study: Google Duplex, Expert systems, Expert system architecture, Functions of various parts, Mechanism and role of inference engine, Types of Expert system, Tuning of expert systems, Role of Expert systems in instrumentation and process control.

Artificial Neural Networks: Structure and function of a single neuron, Artificial neuron models, Types of activation functions, Neural network architectures, Neural learning, Evaluation of networks, Supervised learning, Back propagation training algorithm, Application of neural networks for Classification−algorithm, Unsupervised learning, winner Clustering, Pattern associations, Function approximation, Forecasting. Neural Networks in Control Systems Direct Adaptive Control, Self Tuning Controller, Indirect Adaptive Control, Model Reference Adaptive Control, Internal Model Control; Predictive Control.

Fuzzy Logic: Fuzzy sets and systems, Operations on Fuzzy sets, Fuzzy relations, Membership functions, Fuzzy rule base, Fuzzification and defuzzifications module, Scaling factors, Fuzzy controllers.

Genetic Algorithms: Introduction and concept, Coding, Reproduction, Cross Applications, Swarm intelligence, and their applications.

Hybrid systems: Neuro-fuzzy hybrid systems, genetic neuro hybrid systems, genetic fuzzy hybrid and fuzzy genetic hybrid systems, simplified fuzzy ARTMAP, Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

Text books:

1. Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, by S. Rajasekaran and G. A. Vijayalakshmi Pai, 2nd Edition, PHI Learning, 2003.
2. Soft Computing: Neuro-Fuzzy and Genetic Algorithms by Samir Roy and Udit Chakraborty, 1st Edition, Pearson, 2006.

Reference books:

3. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, 3rd edition , Prentice-Hall International, 2000.
4. Introduction to Artificial Systems by J. M. Zurada, 5th Edition, Jaico Publishing House, 2004.
5. An Introduction to Neural Networks by James A. Anderson, 2nd edition , Prentice Hall of India, New Delhi, 1999.

1. An Introduction to Fuzzy Control by D. Drainkov, H. Hellendoorn and M. Reinfrank,, 6th edition , Springer-Verlag Berlin Heidelberg Publisher, 2008.
2. Fuzzy Logic with Engineering Applications by T. J. Ross, 3rd edition, MIT Press, Inc 2011.
3. Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence by Kosko Bart, Prentice Hall of India, New Delhi, 2001.
4. An Introduction to Genetic Algorithms by Melanie Mitchell, 2nd Edition, MIT Press, 1999.

IN453UD HUMAN ERGONOMICS
PROFESSIONAL ELECTIVE-V

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course includes introduction to the overview of Ergonomics and design relevance. The course explores Man machine environment interaction system and user-friendly design practice, Human compatibility, comfort and adaptability and fundamentals of Ergonomics

COURSE OBJECTIVES:

1. To introduce the fundamentals and scope of Human Ergonomics
2. To give the knowledge of Anthropometry in Human Ergonomics
3. To give the knowledge of the workstation design for human comfort
4. To study the effect of environmental factors on Human body

COURSE OUTCOMES

After successful completion of this course, students will be able

1. To define the need of ergonomics for human comfort
2. To demonstrate the body dimension measuring techniques for ergonomics design
3. To suggest the workstation design criterion for human compatibility
4. To work in interdisciplinary team for designing the infrastructure in concern to HE

RELEVANCE OF PO'S AND STRENGTH OF CORRELATION

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	2	2	-
CO3	1	1	3	1	2	-	-	1	2	-	-	-	3	2	1
CO4	2	1	3	2	-	1	-	2	3	-	-	-	2	1	2

1 – Weakly correlated 2 Moderately Correlated 3 Strongly Correlated

Course Contents

Introduction: Domain ,Physiology objective, Ergonomics/Human factor fundamentals ,Scope and Application of Ergonomics

Anthropometry: Basic definitions, Body dimensions and importance, anthropometric measuring technique

Musculo Skeletal disorders: Muscular energy, Dynamic and static effort, postures, Types of disorders their courses and remedies, fatigue, Boredom.

Workstation design: Design of furniture and lighting computer and office workstations, Operations theatre equipments and their arrangement, Dental chair, Wheel chair.

Environmental Factors: Effects of noise and vibration on the human body, Remedies-Measurements of vibration and noise levels, effect of temperature and humidity on human body.
Design ergonomics in India Scope for exploration

Text Books:

1. Bridger RS ,Introduction to Ergonomics,2nd Edition Taylor and Francis ,2003
2. D.Majumdar and W.Selvamurthy, "Advances in Ergonomics, occupational Health and Safety", New Age international Ltd.
3. Dul.J and Weerdmeester.b,Ergonomics for beginners ,a quick reference guide Taylor and Francis 1993
4.

Reference Books :

1. Grandjaen, Fitting the task to Man", Taylor Pub, 1982
2. Sanders, Human factors in Engg. & Design, MGH, 1993
3. Green W S and Jordan W Human factors in product design ,Taylor and Francis 1999
4. Singh S Ergonomics Interventions for Health and Productivity ,Himanshu Publication, Udaipur New Delhi 2007

IN456UA EMBEDDED SYSTEM LAB
PROFESSIONAL ELECTIVE-V LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

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:

1. Student can improve his/her stimulating learning experience and system design skills using modelling practices and learn more key concepts in embedded hardware architecture, interfaces, buses, software programming design and RTOSes..
2. Imparting knowledge about the fundamental aspects that form the basis of hardware and software designing of embedded systems.

Minimum Ten experiments shall be performed to cover entire curriculum of course IN453UA Embedded system. Practicals using different tools and hardware are to be designed as per requirements. Mini project can be given to students for further learning and implementations.

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.
- **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.

IN456UB FIBER OPTICS AND LASER LAB
PROFESSIONAL ELECTIVE-V LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

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

COURSE OBJECTIVES:

1 To understand the basic concepts of optical fibers and their properties
2 To provide adequate knowledge about the Industrial applications of optical fibers
3 To understand the Laser fundamentals and Industrial application of lasers.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Acquire the knowledge of system of units, classification and essentials of measuring instruments.	01,02	Remembering, Understanding
CO2	Design the construction and operation of various measuring instruments.	01,02	Remembering, Understanding
CO3	Identify the measuring instruments and apply them for quantifying measurements of parameters.	02	Understanding
CO4	Analyse and select proper instrument for given application	03	Applying,

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2

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

LIST OF EXPERIMENTS

Minimum Eight 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.

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.

- **ESE –** The end semester examination (ESE) for this laboratory course shall be based on oral examination 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.

IN456UC ARTIFICIAL INTELLIGENCE LAB
PROFESSIONAL ELECTIVE-V LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION

Minimum Ten experiments shall be performed to cover entire curriculum of course IN453U. The list given below is just a guideline.

COURSE OBJECTIVES:

The objectives of offering this course are to-

4. Provide the most fundamental knowledge to the students so that they can understand AI.
5. Identify problems where artificial intelligence techniques are applicable.
6. Participate in the design of systems that act intelligently and learn from experience.

COURSE OUTCOMES:

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

6. Acquainted with the expert system architecture and artificial intelligence
7. Select appropriate AI technique for a given real world problem
8. Develop neural network, fuzzy logic, genetic algorithm and hybrid system for control system applications
9. Understand the basics of learning and training algorithms
10. Apply the principles of machine learning and AI for practical applications.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	-	-	-	-	-	-	1	2	-
CO2	2	3	2	1	2	1	-	-	-	-	-	-	3	1	-
CO3	3	2	2	1	3	1	-	-	-	-	-	-	2	2	1
CO4	2	2	1	1	1	-	-	-	-	-	-	-	2	2	1
CO5	3	2	2	1	-	-	-	-	-	-	-	-	3	2	1

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

LIST OF EXPERIMENTS

1. Learning rules and activation functions in neural network
2. Development of logic using multilayer perceptron and hebb neuron model
3. Development of supervised learning using neural network (NN) Toolbox
4. Development and testing of perceptron neural network algorithm
5. Development of error back propagation algorithm for control application.
6. Development of auto associative network using outer product rule
7. Development of fuzzy membership functions and fuzzy set properties
8. Development and verification of logic using fuzzy relations
10. Design of a fuzzy controller systems using Fuzzy Logic Toolbox
11. Application development using NN/Fuzzy logic
12. Implementation of Simple Genetic Application
13. Study of adaptive neuro-fuzzy inference system ANFIS Architecture

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.

- **ESE –** The end semester examination (ESE) for this laboratory course shall be based on oral examination 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.

IN456UD HUMAN ERGONOMICS LAB
PROFESSIONAL ELECTIVE-V LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course includes introduction to the overview of Ergonomics and design relevance. The course explores Man machine environment interaction system and user-friendly design practice, Human compatibility, comfort and adaptability and fundamentals of Ergonomics

COURSE OBJECTIVES:

1. To introduce the fundamentals and scope of Human Ergonomics
2. To give the knowledge of Anthropometry in Human Ergonomics
3. To give the knowledge of the workstation design for human comfort
4. To study the effect of environmental factors on Human body

COURSE OUTCOMES

After successful completion of this course, students will be able

1. To define the need of ergonomics for human comfort
2. To demonstrate the body dimension measuring techniques for ergonomics design
3. To suggest the workstation design criterion for human compatibility
4. To work in interdisciplinary team for designing the infrastructure in concern to HE

RELEVANCE OF PO'S AND STRENGTH OF CORRELATION

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	2	2	-
CO3	1	1	3	1	2	-	-	1	2	-	-	-	3	2	1
CO4	2	1	3	2	-	1	-	2	3	-	-	-	2	1	2

1 – Weakly correlated 2 Moderately Correlated 3 Strongly Correlated

LIST OF EXPERIMENTS

This lab consisting of the assignments/study of design/Design procedures/ergonomic standards consideration/case studies/visit to ergonomic lab or hospital

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.

- **ESE –** The end semester examination (ESE) for this laboratory course shall be based on oral examination 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

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

Department of Instrumetation Engineering

Scheme for Semester VI of B. Tech. (Instrumentation Engineering) with effect from academic year 2020-21

Option-II

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme						
							Theory			Practical		Total	Credit
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
IN351U	Process Instrumentation	PC	3	…	…	3	30	10	60	…	…	100	3
IN352U	Distributed Control System	PC	3	…	…	3	30	10	60	…	…	100	3
IN353U	Control System Design	PC	3	1	…	4	30	10	60	…	…	100	4
IN354U	Professional Elective- II	PE	3	…	…	3	30	10	60	…	…	100	3
IN355U	Open Elective-II	OE	3	…	…	3	30	10	60	…	…	100	3
IN356U	Process Instrumentation Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN357U	Distributed Control System Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN358U	Control System Design Lab	PC	…	…	2	2	…	…	…	25	25	50	1
IN359U	Professional Elective- II Lab	PE	…	…	2	2	…	…	…	25	25	50	1
IN360U	Miniproject	PS	…	…	4	4	…	…	…	25	25	50	2
SH481U*	**Accounts and Finance for Entrepreneurs**	**HM**	**2**	**…**	**…**	**2**	**30**	**10**	**60**	**…**	**…**	**100**	**2**
IN452U	**Analytical Instrumentation**	**PC**	**2**	**…**	**…**	**2**	**30**	**10**	**60**	**…**	**…**	**100**	**2**
Total			**19**	**1**	**12**	**32**	**210**	**70**	**420**	**125**	**125**	**950**	**26**

Professional Elective-II

A. Digital Signal Processing
B. Industrial Internet of Things (IIoT)
C. Instrumentation in Unit Operations
D. BioMedical Signal Processing

Open Elective-II

A. Automotive Instrumentation
B. Industrial Measurement
C. Analytical Instrumentation
D. Pollution Control and Management

L : Lecture **T: Tutorial** **P: Practical** **MSE: Mid Semester Examination**
ISA :Internal Sessional Assessment **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

Note: **1. ESE (TH) duration is three hours and MSE (TH) duration is two hours for all theory courses .**

*** Student can do this course through MOOC/SWAYAM**

IN351U PROCESS INSTRUMENTATION

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

To introduce terminology, concepts and practices of process modeling and automatic process control. It gives an overview of process control design. The course will cover process characteristics, Multiloop control, Different process control loop analysis tuning of PID Controller for different process and their response to change in load and set point.

COURSE OBJECTIVES:

1. To introduce students terminology, concepts, and practices of process modeling and automatic process control.
2. To understand the Design aspects of the process and control system for typical plant and processes.
3. To impart knowledgeable in the design of control systems and controller tuning for processes.
4. To integrate various process loop components

DESIRABLE AWARENESS/SKILLS:

Process Measurement, Control strategies, Dynamic model, PID tuning, Design of advance control system

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the process control loop	1,2	Remember,Understand
CO2	Operate and control different loop in industrial process	2,3	Understand,apply
CO3	Design the mathematical modeling for basic process elements	2,3,4	Understand,apply,analyze
CO4	To apply various control techniques to processes	2,3	Understand,apply,
CO5	To apply different controller tuning methods for design controller	3,4,5	apply,analyze,evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	1	-	2	1	-	-	-	-	-	-	1	-	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	3	-
CO4	2	3	2	-	1	-	2	-	-	-	-	3	-	-	2
CO5	3	3	1	3	3	2	-	-	-	-	2	-	-	-	-

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

Course Content

Introduction to process control

Incentives of Chemical process control systems,Design aspect of process control, regulatory and servo control, classification of variables. Process characteristics: Process equation, degrees of freedom, Self-regulating processes, interacting and non- interacting processes, Process lag, inverse response, load disturbance and their effect on processes

Modeling of chemical processes:

The necessity of a mathematical model, state variables and state equations, additional equations, additional elements of the mathematical models; dead time; modeling difficulties; the input-output model; degrees of freedom and process controllers; transfer function of a process with single/multiple outputs.

Analysis of feedback controlled processes

Steady state gain, Process gain, Process time constant,Input output models of feedback controllers, common measuring devices, transmission lines, final control element effect of on-off, proportional, integral, derivative and composite control actions on the response of a controlled process, their effect with derivations. Generation of control action: control action generation in electronic and pneumatic controllers.

Controller tuning Methods:

Evaluation criteria - IAE, ISE, ITAE. Process reaction curve method, continuous oscillation method, damped oscillation method. Direct synthesis for minimum phase processes, for first order process, Direct synthesis for non minimum phase processes

Multi Loop control

Basic principles and working Implementation issues of Cascade control, Feedforward control, feedback-feedforward control, Ratio control, Selective Control, Split range control. Examples and any special features of the individual loop and industrial applications (CSTR, Heat Exchanger, Distillation, Boiler)

Design of control systems for multi variable processes

Synthesis of alternative control, configurations for multiple input-multiple output processes, interaction, and decoupling of control loops; Relative gain array(RGA), design of control systems for complete plants, some case studies.

Text Books:

1. D.R. Coughanowr, Process Systems Analysis, and Control, McGraw Hill, Singapore, 3rd Edition, 2009.

2. B.W. Bequette, Process Control Modeling, Design and Simulation, Prentice Hall of India, New Delhi, 2004.
3. Seborg, D.E.,Edgar, T.F. and Mellichamp, D.A.(2003). "Process dynamics and control," Wiley, New York.

Reference Books:

1. T. E. Marlin, “Process Control: Designing Processes and Control Systems for Dynamic Performance”, McGraw Hill International Edition, 2000.
2. G. Stephanopoulos, “Chemical Process Control: An Introduction to Theory and Practice”, Prentice Hall of India, New Delhi, 2001
3. Luyben W. L., “Simulation and Control for Chemical Engineering”, Second Edition Mc Graw Hill 1989.
4. Curtis D. Johnson, “Process Instrumentation Technology”, Fourth Edition Prentice Hall of India, New Delhi, 1996.
5. E. Umez- Eronini, “System Dynamics and Control”, Thomason Learning, 2002.

IN352U DISTRIBUTED CONTROL SYSTEM

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION: A distributed control system (DCS) is a computerized control system for a process or plant usually with many control loops, in which autonomous controllers are distributed throughout the system, but there is no central operator supervisory control.

COURSE OBJECTIVES:

1. To introduce the basic in Industrial automation instrumentation
2. To explain the working principle and operation of PLC .
3. To explain the basic of DCS and SCADA.
4. To apply DCS and SCADA in any process plant.

DESIRABLE AWARENESS/SKILLS:

To understand operation of PLC,DCS and SCADA in process industries.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the basic operation and selection criteria of PLC.	1	Remembering, Understanding
CO2	How to develop the programming by using PLC	2,3	Remembering, Understanding
CO3	Understand basic of DCS and automation tools.	4	Remembering, Understanding
CO4	Understand the basic of SCADA.	5	Remembering, Understanding
CO5	Apply the concepts of process control to the automation of processes	5	Remembering, Understanding

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	1	2	2	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	2	2	-	-	-	-	-	-	-	-	2	3	2
CO5	3	3	3	2	2	1		2	-	-	1	2	3	3	3

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

Course Content

Programmable Logic Controller: Introduction, architecture, definition of discrete-state process control, discrete – state variables, process specifications, event sequence description.

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, 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.

Ladder diagram:

Background, ladder diagram elements, ladder diagram examples, programmable controllers: relay sequencer, programmable controllers, programmable controller operation, programming, advanced features, ladder diagrams and programming for some typical examples of process control using PLC.

Distributed Control Systems (DCS):

Introduction, difference between DCS and centralized computing system. Block diagram of DCS, data highways, multiplexers and remote sensing terminal units Study of various aspects of DCS like communication protocol, displays, cables etc., various system architectures of DCS.

Industrial Applications of Automation Tools :HART protocol, frame structure, programming, implementation examples, advantages and limitations of field bus, FDS configuration, comparison with other field bus standards including device net, profibus, control net, CAN, industrial Ethernet, MAP and TOP.

Supervisory Control And Data Acquisition (SCADA): Introduction to supervisory control and data acquisition (SCADA) as applied to process control systems: Introduction to various SCADA packages, study of RSVIEW32 (AB make package) development of mimics using RSVIEW32 SCADA package, Study of iFix SCADA package, WinCC.

PLC, SCADA, DCS and open system for following plants: cement plant, thermal power plant, power plant, steel plant, glass manufacturing plant, paper and pulp plant.

Text Books:

1. Instruments Engineers Handbook: VoL-II, Process Control by Bela G. Liptak, Third edition,Chilton.1995
2. Programmable Logic Controller by J.D.Otter, first edition, (PHI), 1987.

Reference Books:

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

IN353U CONTROL SYSTEM DESIGN

Teaching Scheme: 03L+ 01 T; Total: 04 **Credits:** 04
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This is a course on modern digital control systems. This course is designed to provide students a thorough knowledge on linear control systems and its design background. This course is suitable for prefinal year UG and first year PG students who are interested to work in the field of control theory, automation and its applications.

DESIRABLE AWARENESS:

Knowledge of basic control systems and computer skills, modeling, and control strategies, dynamic model, PID tuning, Bode and root locus

COURSE OBJECTIVES:

The objectives of offering this course are to-
To learn the concept of compensation and to realize compensator for a system using active and passive elements. To understand the concept of state and to be able to represent a system in the state space format and to solve the state equation and familiarize with STM and its properties. To design a control system using state space techniques including state feedback control and full order observer. To understand the basic control system design schemes, the concept of pole placement. To be able to analyze and design a control system including realization of simple controllers.

COURSE OUTCOMES:

On the successful completion of this course, students will be able to -
1. understand the concept of state space
2. design and realize a compensator for a physical system,
3. modeling concepts of systems in state space
4. Represent a physical system in state space format and analyze and realize a stability, controllability, observability using state space technique.
5. Analyze the state feedback in a system and pole placement

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the Concept of state space	1,2	Remember,Understand
CO2	Compensators concepts: phase lag/lead	2,3	Understand,apply

CO3	Concepts of mathematical modeling for control systems design	2,3,4	Understand,apply,analyze
CO4	Concepts of stability, controllability, observability	2,3	Understand,apply,
CO5	To apply pole placement techniques	3,4,5	apply,analyze,evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2					1			1					
CO2	1				2				2			3	2	2	
CO3	1	2		1				1	2						
CO4	1					1						2		2	
CO5	1		2				2			2			2		

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

Course Content

State Space Analysis

Introduction to state space analysis Important definitions – state, state variable, state vector, state space, state equation, output equation. State space representation for electrical network, nth order differential equation, and transfer function. Conversion of transfer function to state model and vice versa. Concept of diagonalization.

Representation and Stability Analysis in State Space

Concept of Eigenvalues and Eigenvectors, State Space Representation, diagonalization of system matrices with distinct and repeated eigenvalues, Vander Monde matrix. Solution of homogeneous and non-homogeneous state equation in standard form, state transition matrix (STM) and its properties, Evaluation of STM by Laplace transform method, infinite series, Cayley Hamilton method, Similarity transformation method.

Modeling Concepts for Control System Design

Modelling of Mechanical Systems in State Space, Electrical Systems in state space, Modeling of Level and pressure systems in state space, DC motor modeling, State space to transfer function and vice versa for real time systems. Analysis of above various models for controlling and design purposes.

Design of Control Systems

Introduction; Approaches to System Design; Cascade Compensation Networks; Phase-Lead Design Using the Bode Diagram; Phase-Lag Design Using the Bode Diagram; Design of Phase lead-lag, Design on the Bode Diagram Using Analytical Methods; Introduction to Phase-Lead Design Using the Root Locus; Introduction to Phase-Lag/Lead-lag Design Using the Root Locus; Systems with a Prefilter; Design for Deadbeat Response; Design Examples.

Design concepts in state space I

Concept of controllability and observability, controllability and observability Tests, condition for controllability and observability from the system matrices in canonical form, Jordan canonical form, effect of pole zero cancellation on the controllability and observability of the system, duality property.

Design concepts in state space II

State variable feedback, control system design via pole placement: necessary and sufficient condition, derivation for state feedback gain matrix K through sufficiency condition, Ackermann formula, coefficient comparison method. State observer: necessity, types, theory, design of full order state observer, principle of duality between state feedback gain matrix K and observer gain matrix.

Text books:

1. G. Goodwin, S. Graebe, Mario Salgado, Control System Design , Pearson Education, 2000.
2. G. Franklin, J. Powell, A. Naeini,Feedback Control of Dynamic Systems, Pearson Education, Sixth Edition, 2010.
3. B. S. Manke, “Control System Design”, 1st ed., Khanna Publishers, New Delhi, 2007.
4. K. Ogata, Control Engineering, Modern Prentice Hall Publications, Fifth Edition, 2010.

Reference Books:

1. K. Ogata, “Modern Control Engineering," Prentice Hall of India Pvt. Ltd.
2. M. Gopal, “Digital Control and State Variable Methods”, Tata McGraw-Hill.
3. M. N. Bandyopadhyay, “Control Engineering – Theory and Practice”, Prentice Hall of India Ltd. Delhi.
4. J. Nagrath, M. Gopal “Control System Engineering”, 5th Edition. New Age International Publishers
5. Benjamin C. Kuo, “Automatic Control Engineering”, Prentice Hall of India Pvt. Ltd.
6. Benjamin C. Kuo “Digital Control System”, Prentice Hall of India Pvt. Ltd.

IN354UA DIGITAL SIGNAL PROCESSING
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Digital Signal Processing (DSP) is concerned with the representation, transformation and manipulation of signals on a computer. ... The course emphasizes understanding and implementations of theoretical concepts, methods and algorithms.

PREREQUISITE: Knowledge of basic signals and systems

COURSE OBJECTIVES:

1. To elaborate Sampling theorem, classification of discrete signals and systems
2. To analyze DT signals with FFT and DTFT
3. To describe Frequency response of LTI system
4. To introduce Digital filters and analyze the response
5. To demonstrate DSP Applications in electrical engineering

COURSE OUTCOMES:

Student will be able to

1. Sample and reconstruct any analog signal
2. Find frequency response of LTI system
3. Find Fourier Transform of discrete signals
4. Design of IIR & FIR filter and implementation of them

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand and remember sampling and reconstruction of signal	1,2	Remember,Understand
CO2	Concepts of frequency response	2,3	Understand,apply
CO3	Concepts of mathematical applications in signal processing	2,3,4	Understand,apply,analyze
CO4	Concepts of design of filters	3,4,5	apply,analyze,evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2					1			1					
CO2	1				2				2			3	2	2	
CO3	1	2							2						
CO4	1					1						2		2	
CO5	1		2				2			2			2		

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

Course Contents

DSP Preliminaries, Sampling, DT signals, sampling theorem in time domain, sampling of analog signals, recovery of analog signals, and analytical treatment with examples, mapping between analog frequencies to digital frequency, representation of signals as vectors, concept of Basis function and orthogonality. Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

Discrete Fourier Transform

DTFT, Definition, Frequency domain sampling , DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm, Linear filtering using overlap add and overlap save method, Introduction to Discrete Cosine Transform. Revision to Z-transform and its properties.

IIR Filter Design

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by approximation of derivatives, , IIR filter design by impulse invariance method, Bilinear transformation method, warping effect. Characteristics of Butterworth filters, Chebyshev filters and elliptic filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Finite word length effect in IIR filter design

FIR Filter Design

Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filter realization using direct form, cascade form and lattice form, Finite word length effect in FIR filter design.

Filter Realization

Structures for FIR filters, Structures for IIR filters, State-space analysis and filter structures, Fixed point and floating-point representation of numbers, Errors resulting from rounding and truncating, Quantization effects of filter coefficients, Round-off effects of digital filters.

Multirate DSP and Introduction to DSP Processor

Concept of Multirate DSP, Sampling rate conversion by a non-integer factor, Design of two stage sampling rate converter, General Architecture of DSP, Case Study of TMS320C67XX, Introduction to Code composer studio. Application of DSP to Voice Processing, Music processing, Image processing and Radar processing.

Text Books:

1. Chen, C.T., Digital Signal Processing: Spectral Computation & Filter Design, Oxford Univ. Press, 2001.
2. Proakis, J.G., Manolakis, D.G., Digital Signal Processing: Principles, Algorithms, & Applications, Prentice Hall of India, 3rd Edition, 2007.
3. Ifeachor, E.C., & Jervis, B.W., Digital Signal Processing: A Practical Approach, Pearson Education Asia, 2nd Edition, 2009.

Reference books

1. Mitra, S.K., Digital Signal Processing: A Computer-Based Approach, McGraw Hill, NY, 4th Edition, 2011.
2. A.V. Oppenheim, R. W. Schafer, J. R. Buck, ”Discrete Time Signal Processing”, 2nd Edition Prentice Hall, ISBN 978-81-317-0492-9.
3. Li Tan, Jean Jiang, “ Digital Signal Processing : Fundamentals and applications“ Academic press,

IN354UB INDUSTRIAL INTERNET OF THINGS (IIOT)
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

COURSE OBJECTIVES:

1. Introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value
2. Bring the IoT perspective in thinking and building solutions
3. Introduce the tools and techniques that enable IoT solution and Security aspects

DESIRABLE AWARENESS/SKILLS:

Basics of Internet of Things (IoT).

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	State the purpose of IIOT	01,02	Remembering, Understanding
CO2	List the components of IIOT.	01,02	Remembering, Understanding
CO3	List typical applications of IIOT in the industry.	03	Applying
CO4	Explain the purpose of IOT protocol.	03,04	Applying, Analyzing
CO5	List and describe the types of IOT protocols for M2M communication.	05, 04	Analyzing, Evaluating

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	3	2	2	1		3	-	-	1	2	2	2	2

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

Course Content

Introduction: Introduction: Sensing & actuation, Communication-IEEE 802.15.4 Zigbee, 6LoWPAN, Wireless HART, Z-Wave, ISA 100, Bluetooth, NFC, RFID

Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories

Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artical Intelligence, Big Data and Advanced Analysis Cybersecurity in Industry 4.0,

Basics of Industrial IoT: Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems.

IIoT-Introduction, Industrial IoT: Business Model and Referece Architerture, IIoT-Business Models-

Industrial IoT- Layers: IIoT Sensing, IIoT Processing, Communication, Industrial IoT- Layers: IIoT Communication, IIoT Networking. Industrial IoT: Big Data Analytics and Software Dened Networks: IIoT Analytics - Introduction, Machine Learning and Data Science, R and Julia Programming, Data Management with Hadoop.

Industrial IoT: Big Data Analytics and Software Dened Networks: SDN in IIoT, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT. Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT,

Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry. Industrial IoT-Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Case studies. Self-Referential Structures and Introduction to Lists; Advanced Topics

Text Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1 st Edition, Academic Press, 2014. (ISBN-13: 978-0124076846)
2. Introduction to Industry 4.0 and Industrial Internet of Things NPTEL Course

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1 stEdition, VPT, 2014. (ISBN-13: 978-8173719547) 2)
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1 st Edition, Apress Publications, 2013. (ISBN-13: 978- 1430257400)

IN354UC INSTRUMENTATION IN UNIT OPERATION
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The course is designed to familiarize the student with the unit operations and the instrumentation systems. This course contains the introduction of unit operations and its application to the present industry. The course contains basic principles of design of controllers for basic operations like evaporation, distillation etc.

COURSE OBJECTIVES:

1. To introduce the basic unit operation using instrumentation
2. To explain the working principle different unit operations in industry .

DESIRABLE AWARENESS/SKILLS:

To understand basic operation of unit operation equipment in process industries.

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand block diagram of chemical process.	01,02	Remembering, Understanding
CO2	Understand classification of unit operation.	01,02	Remembering, Understanding
CO3	Understand the process of distillation and other unit operation equipment.	01,02	Remembering, Understanding
CO4	Select suitable size reduction equipment, separation equipment and proper conveying medium	01,02	Remembering, Understanding
CO5	Apply the concepts of process control to the automation of processes	01,02	Remembering, Understanding

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-
CO3	1	3	2	2	2	-	-	-	-	-	-	-	2	1	1
CO4	1	2	3	2	-	-	-	-	-	-	-	-	2	1	2
CO5	3	3	3	3	2	1		-	-	-	1	2	3	2	3

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

Course Content

Unit operation and unit process concept: block diagram of chemical process, classification of unit operation, material and energy balance, batch and continuous process

Distillation : Vapor- liquid equilibrium, equipment setup, Flash Distillation, Batch Distillation, Continuous Distillation, operational features, construction and working only.

Evaporation: Liquid characteristics, types of evaporators, principle and operation of single and multiple effect evaporators.

Drying: Classification of dryer, basic principle and operation, Types of dryers: tray drier, rotary drum drier, vacuum drier, fluidized bed drier, Dryer control.

Filtration : Mechanism of filtration, types of filters.

Crystallization: Types of crystallizers, principle and operation.

Size reduction : Size reduction and mechanical separation operations: Crushing and grinding, size separation and screening. Selection criteria and considerations for equipment used for size reduction and mechanical separation.

Heat Exchangers: Basic modes of heat transfer, basic laws, Heat transfer equipments: double pipe heat exchanger, shell and tube heat exchanger: type of shell and tube exchanger, Temperature pattern in heat exchanger

Unit operations in different industries: Identification and justification of unit operations used in different industries like food, paper, sugar, cement, fertilizer, Petrochemical industry with help of process flow diagram `

Text Books:

1. Warren L. McCabe, Julian C. Smith, Peter Harroitt “Unit Operation in Chemical Engineering” McGraw Hill. Fifth ed., 2005.

Reference Books:

1. Instrumentation Engineers Handbook Vol II: Process Control and Optimization by Bela G. Liptak, 4th edition, CRC Press, 2006.
2. Automatic Process Control by P. Harriot, Tata McGraw-Hill Publishing Company Limited.
3. Chemical Engineer’s Handbook by Perry, 6thedition , McGraw hill int. student ed.
4. Elementary Principles of Chemical Processes by Fedler, Rotsseau, Herriot, Wiley, 1978.
5. Outline of Chemical Technology by Gopalrao, M. Sitting, 2nd edition, East West Press, 1973.

IN354UD BIOMEDICAL SIGNAL PROCESSING
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Students with a good background in Signals and Systems are prepared to take this course. This course includes introduction to thebiomedicalsignals, analysis of the biomedical signals using signal processing techniques .Also the data reduction techniques for biomedical signals will be studied

COURSE OBJECTIVES:

1. To introduce the biomedical signal origin & dynamics
2. To give the basic knowledge of signal processing onbiomedical signals
3. To give the knowledge about events detection (viz. P, QRS and T wave in ECG)
4. To study the filtering techniques, Neurological Signal Processing techniques
5. To study the various biomedical signal Data compression techniques

COURSE OUTCOMES

After successful completion of this course, students will be able to

1. Define the origin, source and characteristics of biomedical signals,
2. Differentiate the basics of signal processing techniques
3. Demonstrate the event detection algorithms and inferences in ECG waveform
4. Demonstrate the auto regressive models for EEGwaveform signal analysis
5. Implement, categorize the data compression techniques with algorithm

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	1	2	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	1	-	2	-		-	-	-	1	2	2	2	2

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

Course Contents

Introduction to biomedical signals: The nature of biomedical signals, Examples of Biomedicalsignals, objectives of biomedical signal analysis, Sources of noise inbiomedical signal recordings, Difficulties in biomedical signal analysis

Cardiological signal processing: Basic electrocardiography, ECG signal characteristics, Powerspectrum of ECG, Band pass filtering technique, Differentiation technique, Template matching, approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection, Dicrotic Notch Detection ,Correlation coefficients.

Neurological Signal Processing: The brain and its potentials, the electrophysiological origin ofbrain waves, The EEG signal and its characteristics, EEG analysis Auto Regressive (A.R.)modeling, Sleep Stage analysis

Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, software forsignal averaging, limitation of signal averaging.

Adaptive Filters: Principal noise canceller model, 60 Hz adaptive cancelling using sine wavemodel, applications of adaptive filtering removal of artifacts of one signal embedded in another -Maternal-Fetal ECG.

Data Reduction Techniques: Lossy and Lossless data reduction Algorithms, Direct ECG datacompression techniques, Turning point algorithm, AZTEC Algorithm, Fan algorithm, Huffmancoding.

Text Books:

1. Biomedical Signal Processing Principles and Techniques, D. C. Reddy, Tata McGraw-Hill, 2005.
2. Biomedical Signal Analysis A case study approach, Rangaraj M. Rangayyan, John Wiley, 2002.

Reference Book:

3. Biomedical Digital Signal Processing, Willis J. Tompkins, Prentice Hall of India publications/ Eastern Economy Edition, 2nd Print, 2000.
4. Biomedical Instrumentation and Measurements, L.Cromwell, F.Weibell Prentice Hall of India Pvt. Ltd publication, 1979.
5. Hand book of Biomedical Instrumentation, Khandpur R. S., 2nd edition, Prentice Hall of India Pvt. Ltd, New Delhi, India, 1996.

IN355UA AUTOMOTIVE INSTRUMENTATION
OPEN ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Automobile Industry is one of the most important industries. The automobiles are getting converted from mechanical system to highly modernized Electro-mechanical systems and from driver to driverless vehicle. The manufacturers of automobiles are increasing usage of sensors and control system to improve safety measures and also to increase comfort of users. This subject is intended to make student aware with sensors and other technologies used in modern automobiles.

COURSE OBJECTIVES:

3. To evaluate the sensor and measuring system of automobile.
4. To acquire knowledge of various automotive standards and Protocols.
5. To design the basic modeling and control scheme for automotive systems.

DESIRABLE AWARENESS/SKILLS:

Nil.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	evaluate the sensor and measuring system of automobile	01,02	Remembering, Understanding
CO2	acquire knowledge of various automotive standards and Protocols.	01,02	Remembering, Understanding
CO3	Design the basic modelling and control scheme for automotive systems and instruments for automotive applications.	03	Applying
CO4	Analyze the use of instruments in automotive industry.	03,04	Applying, Analyzing

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2

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

Course Content

Introduction:
Introduction of automobile system, current trends in automobiles with emphasis on increasing role of electronics and software, overview of generic automotive control ECU functioning, overview of typical automotive subsystems and components, AUTOSAR.

Engine management systems
Basic sensor arrangement, types of sensors such as oxygen sensors, crank angle position sensors, Fuel metering/ vehicle speed sensors, flow sensor, temperature, air mass flow sensors, throttle position sensor, solenoids etc., algorithms for engine control including open loop and closed loop control system, electronic ignition, EGR for exhaust emission control.

Vehicle power train and motion control
Electronic transmission control, adaptive power Steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control.

Active and passive safety system
Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program, air bags

Automotive standards and protocols
Automotive standards like CAN protocol, Lin protocol, flex ray, OBD-II, CAN FD, automotive Ethernet etc. Automotive standards like MISRA, functional safety standards (ISO 26262).

System design and energy management
BMS (battery management system), FCM (fuel control module), principles of system design, assembly process of automotives and instrumentation systems.

Text Books:

1. A. K. Babu, Automotive Electrical and Electronics, Khanna Book Publishing, 2016

Reference Books:

1. William B. Riddens, “Understanding Automotive Electronics”, 5th Edition,(Buterworth Heinemann Woburn)(1998)
2. Tom Weather Jr and Cland C. Hutter,” Automotive Computers and Control system” Prentice Hall Inc. New Jeresy
3. Jiri Marek,Hans Peter trah ,”Sensors applications, sensors for automotive Technology” 1st Edition.
4. T.Mellard, Automotive Electronics System “1987 by Heinenmann Professional.

IN355UB INDUSTRIAL MEASUREMENT
OPEN ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

To equip the students with relevant knowledge to suit the industrial requirements. The main goal of an industrial measurement course for engineering students are shaped by a variety of applications including control quality assurance performance testing design. In this course adapted to main objectives to provide a fundamental background in the theory of industrial instrumentation and Measurement system performers and to establish the physical principles and practical techniques used to measure those quantities most important for instrumentation applications.

COURSE OBJECTIVES:

1. To select the relevant transducers for measuring various physical parameters.
2. The students will acquire familiarity about various industrial instrumentation types, their parameters and different types of measurement techniques.
3. To have an adequate knowledge about temperature and pressure transducers
4. To know about various flow and level measurement techniques adopted in industrial environment
5. Exposure to various force, torque, density and velocity measuring instruments

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the basic industrial parameters	1,2	Remember Understand
CO2	Ability to understand and analyze Instrumentation systems and their applications to various industries	3,4	Apply,Analys
CO3	Selecting various transducer for measuring various parameters	2,3	Understand, apply
CO4	Understand the measuring techniques for motion and vibration measuring sensors and transducers	1,2	Remember Understand
CO5	Apply the measurement tequinics for humidity, dew point, viscosity, nuclear radiation measurements	2,4,5	Understand, analyses apply

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	1	1	-	-	-	-	-	-	-	-	1	-
CO2	3	2	3	2	-	-	1	-	-	-	-	2	2	-	-
CO3	2	3	2	2	3	2	2	-	-	-	-	-	-	-	-
CO4	3	2	3	-	2	-	-	2	-	-	2	-	-	-	2
CO5	3	3	3	3	2	1	-	-	-	-		-	-	-	-

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

Course Content

Motion and Vibration Measurement:
Translational and rotational displacement using potentiometers, Strain gauges, Differential transformer, Different types of tachometers, Accelerometers

Pressure Measurement:
Moderate pressure measurement, Bourdon tube, Bellows and diaphragms, High pressure measurement: Piezoelectric, Electric resistance, Low pressure measurement: Mcleod gauge, Knudsen Gauge, Viscosity gauge, Thermal conductivity, Ionization gauge, Dead weight gauges.

Flow Measurement:
Obstruction meter, Orifice, Nozzle, Venturi, Pitot tube, Rotameter, Turbine, Electromagnetic, Vortex, Positive displacement, Anemometers, Weirs and flumes, Laser Doppler anemometer, Ultrasonic flow meter, Mass flow meter

Temperature Measurement:
Bimetallic thermometers, Liquid-in-glass, Pressure thermometer, Semiconductor sensors, Digital thermometers, Pyrometers.

Level Measurement:
Visual level indicators, Purge method, Buoyancy method, Resistance, Capacitance and inductive probes, Ultrasonic, Laser, Optical fiber, Thermal, Radar, Radiation.

Miscellaneous Measurements:
Humidity, Dew point, Viscosity, nuclear radiation measurements.

Text Books:

1. Doeblin, E.O., Measurement systems, Applications and Design, McGrawHill (1982).
2. Nakra, B. C. and Chaudhry, K. K., Instrumentation Measurement and Analysis, Tata McGrawHill (2003).

Reference Books:

1. Liptak, B.G., Instrumentation Engineers Handbook (Measurement), CRC Press, 2005
2. Patranabis,D.,Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.
3. Eckman D.P., Industrial Instrumentation, Wiley Eastern Limited, 1990.
4. S.K.Singh., Industrial Instrumentation and Control, 3rd Edition, Tata McGraw - Hill Education, 2008.
5. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999

IN355UC ANALYTICAL INSTRUMENTATION
OPEN ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course provides the knowledge of different analytical methods used in chemical analysis and role of instrumentation in it.

COURSE OBJECTIVES:

1. To understand principles of analytical instrumental analysis.
2. To study the theory and design of analytical instruments.
3. To develop problem-solving skills applicable to real-world problems.

DESIRABLE AWARENESS/SKILLS:

Basic sensor and transducers, Instrumentation and Measurements system.

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the capabilities and limitations of analytical instruments.	01,02	Remembering, Understanding
CO2	Learn the advances in analytical instrumentation.	01,02	Understanding
CO3	Select and apply an analytical instrument in the physical, chemical and biological world.	03	Applying
CO4	Analyse and select proper instrument and appreciate the role of instrumentation for given application	03,04	Analyzing Evaluating

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	3	1	-	-	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	2	1	2	-	1	-	-	-	-	1	3	3	1
CO4	2	3	2	2	-	1	-	-	-	-	-	2	2	3	2

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

Course Content

Chemical Analysis and Analytical methods

Classification of Analytical Methods: Classical and instrumental methods, comparison of these methods, classification of instrumental methods (spectral, electro analytical and separative methods)

UV Visible and Spectroscopy: Laws of photometry, Beer and Lambert's law, monochromator. design and monochromator performance, colorimeters, single beam and double beam spectrophotometers, dual wavelength and double monochromatic systems, direct reading multichannel spectrophotometers, diode array rapid scanning spectrophotometers, reverse optics technique.

IR spectroscopy: Instrumentation, sources, detectors, FTIR. Raman Spectrometry, Raman effect, Raman spectrometer components, LASER Raman spectrophotometer Emission and Absorption Spectroscopy.

Emission Spectroscopy: Principle of emission spectroscopy, sources of excitation, DC arc, AC arc, AC spark and Plasma excitation sources, Flame photometry: Principle, instrumentation constructional details, fuel gases, atomizer, burner, optical system, recording system. Interferences in flame photometry, applications, Atomic Absorption Spectroscopy (AAS): Principle, instrumentation-hollow cathode lamps, burners and flames, plasma excitation sources, optical and electronic systems, interferences in AAS, applications.

Nuclear Magnetic Resonance (NMR) Spectrometry:

Principle, nuclear spin, nuclear energy levels, resonance condition, NMR absorption spectra, chemical shift, constructional details of NMR spectrometer, sensitivity enhancement techniques, spin decoupler, Fourier transform NMR spectroscopy;

Mass Spectrometry:

Principle and components of mass spectrometer. magnetic deflection type, time of flight, radio frequency, double focusing, quadrupole type, gas chromatograph mass spectrometer (GCMS) system resolution of mass spectrometer, applications in industry.

Electron and Ion Spectroscopy: Surface spectroscopic techniques, electron spectroscopy for chemical analysis (ESCA), Auger spectroscopy (AES), secondary ion mass spectrometry (SIMS) and ion scattering spectroscopy (ISS). Radio Chemical Instrumentation: Radio chemical methods, radiation detectors, ionization chamber, Geiger Muller counter, proportional counter, scintillation counter, semiconductor detectors, pulse height analyzer. Principle and constructional details of Electron Spin Resonance (ESR) Spectrometry.

X-ray Spectrometry:

X-ray spectrum, Instrumentation for X-ray spectrometry, X-ray diffractometers, X-ray absorption meter. X-Ray fluorescence spectrometry. Electron probe microanalyzer.

Chromatography

Chromatography: classification, Basic definitions**.** Principle and basic parts of gas chromatograph. Components of gas chromatograph like carrier gas, sample injection system, thermal compartment, temperature programming. Detectors-thermal conductivity, flame ionization, electron capture.

Liquid Chromatography: Introduction and its classification, HPLC, Applications of Chromatographs in industries such as process, food and pharmaceuticals.

Text Books:

1. Handbook of Analytical Instruments by R.S. Khandpur, Second ed., 2006. Tata McGrawHill.
2. Instrumental Methods of Analysis by Willard, Merritt, John Aurie Dean, CBS Publishers & Distributors, New Delhi, Seventh ed., 1988.
3. Instrumental Methods of Chemical Analysis by B. K. Sharma, Goyal publications house Meerut , 23th edi., 2004.

Reference Books:

1. Principles of Industrial Instrumentation by D. Patranabis, second edition, Tata McGraw
2. Instrumental Methods of Chemical Analysis by G. W. Ewing, 4th Edi, McGraw Hill, 1975.
3. Analytical Instrumentation Handbook by Bela G Liptak, Chilton, Second ed., 1994.
4. Principles of Instrumental Analysis by Skoog, Holler, Nieman, Thomson books-cole publications, Sixth ed., 2006.

IN355UD POLLUTION CONTROL AND MANAGEMENT
OPEN ELECTIVE-II

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course covers the sources, characteristics and effects of pollution and the methods of controlling the same. The student is expected to know about source inventory and control mechanism.

COURSE OBJECTIVES:

1. To Identify the sources of air, noise and water pollution
2. To understand the concepts involved in control technologies

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	**Descriptor**
CO1	Acquire the knowledge of system of units, classification and essentials of measuring instruments.	01,02	Remembering, Understanding
CO2	Design the construction and operation of various measuring instruments.	01,02	Remembering, Understanding
CO3	Identify the measuring instruments and apply them for quantifying measurements of parameters.	03	Applying
CO4	Analyse and select proper instrument for given application	03,04	Applying, Analyzing
CO5	Calibrate and monitor a variety of electronic instruments	03	Applying

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO5	1	1	1	-				-							

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

Course Content

Introduction

Industrial scenario – Uses of Water by industry – Sources and types of industrial wastewater – Industrial wastewater disposal and environmental impacts – Reasons for treatment of industrial wastewater – Regulatory requirements – Industrial waste survey. – Individual and Common Effluent Treatment Plants – Joint treatment of industrial wastewater.

Industrial Water Pollution Control and Treatment

Advanced wastewater treatment. Industry specific wastewater treatment for chloro- alkali, electroplating, distillery, tannery, pulp and paper, fertilizer, etc.

Sequencing batch reactors – High Rate reactors. Chemical oxidation – Ozonation – Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal – Land Treatment.

Air Pollution Control

Dust control and abatement measures in mines; role of green belts. Control devices for gaseous pollutants with special emphasis on adsorption, absorption, mass transfer, condensation, and combustion. Control of motor vehicle emissions. Indoor air pollution control.

Noise Pollution Control

Noise pollution and management in Mines, Washeries, Power plants, Fertilizer plants, Cement plants, etc. Human Vibrationwhole body vibration problems in opencast mines, health effects and control measures. Ground vibration and air blast, Environmental and health effects; strategic control and abatement measures.

Case Studies

Industrial manufacturing process description, wastewater characteristics and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Petroleum Refining – Chemical industries – Sugar and Distilleries –Dairy – Iron and steel – fertilizers

Text Books:

1. Air Pollution Control Engineering by N.D. Nevers (1995) MC Graw Hill
2. Air Pollution by H.C. Perkins MC Graw Hill (latest edition)
3. Noise Pollution by Tripathy, Debipras (latest edition)

References:

4. Eckenfelder, W.W., (1999) “Industrial Water Pollution Control”, Mc-Graw Hill.
5. Arceivala, S.J., (1998) “Wastewater Treatment for Poll. Control”, Tata McGraw Hill.
6. World Bank Group (1998)”Pollution Prevention and Abatement Handbook – Towards Cleaner Production “, World Bank and UNEP, Washington D.C.

IN 356U PROCESS INSTRUMENTATION LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course introduces the intellectual and motor skills of the students.To give knowledge for selection of different control strategies for process loops It is also capable to apply different methods of tuning PID controllers in the form of electrical, electronics and Pneumatic types. From this course students are able to handle different industrial control loops in the lab.

COURSE OBJECTIVES:

1 Apply different control techniques.
2 Select the proper controller for a specific process
3 Measurement and control different process parameters
4 Assembling skill for different control elements for the specific application
5 Handling of meters and different sensors and transducers.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the process control loop	1,2	Remember,Understand
CO2	Operate and control different loop in industrial process	2,3	Understand,apply
CO3	Design the mathematical modeling for basic process elements	2,3,4	Understand,apply,analyze
CO4	To apply various control techniques to processes	2,3	Understand,apply,
CO5	To apply different controller tuning methods for design controller	3,4,5	apply,analyze,evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	1	-	2	1	-	-	-	-	-	-	1	-	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	3	-
CO4	2	3	2	-	1	-	2	-	-	-	-	3	-	-	2
CO5	3	3	1	3	3	2	-	-	-	-	2	-	-	-	-

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

LIST OF EXPERIMENTS:

Minimum Ten experiments shall be performed to cover the entire curriculum of course **Process Instrumentation Lab.** The list given below is just a guideline

1. Develop a FOPDT/SOPDT model of any process.
2. Effect of control actions on a system with dead time and integrating systems (Using Scilab/LabVIEW MATLAB).
3. Design of an electronic ON-OFF controller and plot the characteristics of natural zone of controller.
4. Design an electronic PID controller and study its response for step input
5. Cascade control trainer (P, PI, PID, On / off) Study of Cascade Control trainer (Flow & Level control)
6. **Level control trainer:**
    a. Study of open loop response (Manual control)
    b. Study of on/off controller
    c. Study of proportional controller
    d. Study of proportional integral controller
    e. Study of proportional derivative controller
    f. Study of proportional integral derivative controller
    g. Tuning of controller (Open loop method)
    h. Tuning of controller (Closed loop method)
7. **Flow control trainer**
    a. Study of open loop response (Manual control)
    b. Study of on/off controller
    c. Study of proportional controller
    d. Study of proportional integral controller
    e. Study of proportional derivative controller
    f. Study of proportional integral derivative controller
    g. Tuning of controller (Open loop method)
    h. Tuning of controller (Closed loop method)
8. Study of Pressure control trainer
9. Study of the temperature control loop with a controller (P,PI,PID)
10. Time constant of Interacting and non-interacting of process
11. Non linear level control trainer (Spherical and conical tank)
12. To determine the mathematical model of the given process.
13. To determine the constants of PID controllers by given method.

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.

- **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.

IN357U DISTRIBUTED CONTROL SYSTEM LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This lab course provides the knowledge of various automation tools like PLC, DCS and SCADA in any process industry.

COURSE OBJECTIVES:

1. To introduce the basic in Industrial automation instrumentation
2. To explain the working principle and operation of PLC .
3. To explain the basic of DCS and SCADA.
4. To apply DCS and SCADA in any process plant.

DESIRABLE AWARENESS/SKILLS:

To understand operation of PLC,DCS and SCADA in process industries.

COURSE OUTCOMES:

CO	After the completion of the course the student will be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Understand the basic operation and selection criteria of PLC.	1	Remembering, Understanding
CO2	How to develop the programming by using PLC	2,3	Remembering, Understanding
CO3	Understand basic of DCS and automation tools.	4	Remembering, Understanding
CO4	Understand the basic of SCADA.	5	Remembering, Understanding
CO5	Apply the concepts of process control to the automation of processes	5	Remembering, Understanding

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	1	2	2	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	2	2	-	-	-	-	-	-	-	-	2	3	2
CO5	3	3	3	2	2	1		2	-	-	1	2	3	3	3

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

LIST OF EXPERIMENT:

Minimum Ten experiments shall be performed to cover entire curriculum of course IN352U. The list given below is just a guideline.

1. Develop ladder logic program for elevator control.
2. Develop ladder logic program for stepper motor control.
3. Develop ladder logic program for interfacing of proximity switch.
4. Develop one application on SCADA.
5. Develop ladder logic program for interfacing liquid level sensor to PLC
6. Develop ladder logic program for interfacing bottle filling plant to PLC.
7. Develop logic on DCS to implement ratio control.
8. Develop logic on DCS to implement cascade control.
9. Develop logic on DCS to implement level control.
10. Develop logic on DCS to implement temperature control.
11. Develop logic on DCS to implement flow control.
12. Develop logic on DCS to interface pneumatic components.

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.
- **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.

IN358U CONTROL SYSTEM DESIGN LAB

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This is a course on modern digital control systems. This course is designed to provide students a thorough knowledge on linear control systems and its design background. This course is suitable for prefinal year UG and first year PG students who are interested to work in the field of control theory, automation and its applications.

DESIRABLE AWARENESS:

Knowledge of basic control systems and computer skills, modeling, and control strategies, dynamic model, PID tuning, Bode and root locus

COURSE OBJECTIVES:

The objectives of offering this course are to-
To learn the concept of compensation and to realize compensator for a system using active and passive elements. To understand the concept of state and to be able to represent a system in the state space format and to solve the state equation and familiarize with STM and its properties. To design a control system using state space techniques including state feedback control and full order observer. To understand the basic control system design schemes, the concept of pole placement. To be able to analyze and design a control system including realization of simple controllers.

COURSE OUTCOMES:

On the successful completion of this course, students will be able to -
1. understand the concept of state space
2. design and realize a compensator for a physical system,
3. modeling concepts of systems in state space
4. Represent a physical system in state space format and analyze and realize a stability, controllability, observability using state space technique.
5. Analyze the state feedback in a system and pole placement

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the Concept of state space	1,2	Remember,Understand
CO2	Compensators concepts: phase lag/lead	2,3	Understand,apply
CO3	Concepts of mathematical modeling for control systems design	2,3,4	Understand,apply,analyze

CO4	Concepts of stability, controllability, observability	2,3	Understand,apply,
CO5	To apply pole placement techniques	3,4,5	apply,analyze,evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2					1			1					
CO2	1				2				2			3	2	2	
CO3	1	2		1				1	2						
CO4	1					1						2		2	
CO5	1		2				2			2			2		

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

LIST OF EXPERIMENT:

(General Guidelines). At least 10 experiments to be performed.

1. Study of magnitude and phase characteristics of lead, lag and lag-lead compensator (Use any software).
2. Design a lead / lag compensator for getting desired specifications by root locus approach.
3. Design a lead / lag compensator for getting desired specifications by Bode plot approach.
4. Computation of state transition matrix by Laplace transform (homogeneous and/or non-homogeneous case) using any software
5. Computation of state transition matrix by Calay-Hamilton method (homogeneous and/or non-homogeneous case) using any software
6. Check for observability and Controllability for suitable example using any related software.
7. Verify State feedback control using pole placement.
8. Convert a continuous time mechanical system into state space and check responses using software.
9. Convert a continuous time electrical system into state space and check responses using software.
10. DC motor modeling and its response using software/hardware
11. Modeling of level/flow systems and its real time response using experimental set-up
12. Modeling of pressure/temperature control systems and its real time response using experimental set-up
13. Design State observer and validate it by software.
14. Software programming for determination of state space representation for given transfer function and vice-versa .
15. Implementation of digital controller for physical system.
16. Implementation of State Observer design and its analysis
17. Implementation of Tracking Problem in State Feedback Design

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.
- **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.

IN359UA DIGITAL SIGNAL PROCESSING LAB
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Digital Signal Processing (DSP) is concerned with the representation, transformation and manipulation of signals on a computer. ... The course emphasizes understanding and implementations of theoretical concepts, methods and algorithms.

PREREQUISITE: Knowledge of basic signals and systems

COURSE OBJECTIVES:

6. To elaborate Sampling theorem, classification of discrete signals and systems
7. To analyze DT signals with FFT and DTFT
8. To describe Frequency response of LTI system
9. To introduce Digital filters and analyze the response
10. To demonstrate DSP Applications in electrical engineering

COURSE OUTCOMES:

Student will be able to

5. Sample and reconstruct any analog signal
6. Find frequency response of LTI system
7. Find Fourier Transform of discrete signals
8. Design of IIR & FIR filter and implementation of them

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand and remember sampling and reconstruction of signal	1,2	Remember,Understand
CO2	Concepts of frequency response	2,3	Understand,apply
CO3	Concepts of mathematical applications in signal processing	2,3,4	Understand,apply,analyze
CO4	Concepts of design of filters	3,4,5	apply,analyze,evaluate

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2					1			1					
CO2	1				2				2			3	2	2	
CO3	1	2							2						
CO4	1					1						2		2	
CO5	1		2				2			2			2		

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

LIST OF EXPERIMENT:

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

1. Implement the sampling theorem and aliasing effects by sampling an analog signal with various sampling frequencies.
2. To study the properties of DFT. Write programs to confirm all DFT properties.
3. To study the circular convolution for calculation of linear convolution and aliasing effect. Take two sequences of length
4. Write a program to find 4 point circular convolution and compare the result with 8 point circular convolution to study aliasing in time domain. 4. (a) To find Z and inverse Z transform and pole zero plot of Z-transfer function. (b) To solve the difference equation and find the system response using Z transform.
5. To plot the poles and zeros of a transfer function when the coefficients of the transfer function are given, study stability of different transfer functions.
6. To study the effect of different windows on FIR filter response. Pass the filter coefficients designed in experiment 6 via different windows and see the effect on the filter response.
7. Design Butterworth filter using Bilnear transformation method for LPF and write a program to draw the frequency response of the filter.
8. To plot the mapping function used in bilinear transformation method of IIR filter design.(assignment may be given)
9. Effect of coefficient quantization on the impulse response of the filter using direct form I and II realization and cascade realization.(theory assignment)
10. Design and implement two stage sampling rate converter.
11. Computation of DCT and IDCT of a discrete time signal and comment on energy compaction density.
12. To implement at least one of the following operations using DSP Processor i) Linear and Circular convolution. ii) Low pass filter an audio signal input to DSK with FIR filter. iii) Low pass filter an audio signal input to DSK with IIR filter. iv) To generate sine wave using lookup table with table values generated within the programme.

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.
- **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.

IN359UB INDUSTRIAL IOT LAB
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

COURSE OBJECTIVES:

1. Introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value
2. Bring the IoT perspective in thinking and building solutions
3. Introduce the tools and techniques that enable IoT solution and Security aspects

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	State the purpose of IIOT	01,02	Remembering, Understanding
CO2	List the components of IIOT.	01,02	Remembering, Understanding
CO3	List typical applications of IIOT in the industry.	03	Applying
CO4	Explain the purpose of IOT protocol.	03,04	Applying, Analyzing
CO5	List and describe the types of IOT protocols for M2M communication.	05, 04	Analyzing, Evaluating

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	3	2	2	1		3	-	-	1	2	2	2	2

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

LIST OF EXPERIMENT:

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

Kits	Practicals
Basic IoT (Arduino)	Arduino Uno in Brief description and working
	Practical1: Displaying Sensor data in Arduino IDE Serial Monitor Screen
	Practical2: Posting Sensor Data to Osmosis Cloud Platform using GSM Module
	Practical3: Trigerring SMS using GSM Module
	Practical4: Posting Sensor data to Osmosis Cloud Platform using WiFi module
	Practical5: Store Best Cold Chain Vehicle sensor data into Big Data NoSQL MongoDB
	Practical6: Stream Best Cold Chain vehicle sensor data using REST Web services
	Practical7: Resolve Best Cold Chain business problem using Big Data analytics
	Practical8: Visual analytics for Best Cold chain Business Problem
Communication Proctocol-MQTT	MQTT Architecture
	MQTT Topics and Features
	Practical1: Posting Sensor data to Arduino IDE using Node MCU
	Practical2: Publish and Subscribing the message using Topic names
	Practical3: Publish the Sensor data to MQTT Lens
	Practical4: Subscribing the LED using MQTT Lens
	Practical5: Publishing the Sensor data and Subscribing the LED using MQTT Lens
	Practical6: MQTT Wildcard feature
	Practical7: Connect using Username and Password
	Practical8: Home Automation using java and eclipses
	Practical9: Last will and testament feature
	Practical10: Manage Quality of services
	Practical11: Use of Retain flag
Zigbee	Zigbee device s2c Description and Working
	Zigbee Configuration using Xbctu Software
	Practical1: Sending the Sensor data through Coordinator, Router and End-Device.
	Practical2: Creating a Mesh Topology using s2c devices

	Practical3: Creating a Star Topology using s2c devices
	Practical4: Creating a Ring Topology using s2c devices
Environmental Monitoring Kit	This kit consist of Nodes which collects environmental data and send the data to Osmosis Cloud platform throuh gateway device.
	Learn about the Low Power Management of 8 bit Micro controller Devices.
	Making the controller board in a Sleep Mode for low power consumption
	Trigger the circuit once in five minutes frequency to sense the environmental data
	LWPAN communication Protocol
	LoRa communication from node to Gateway.
	Long range RF communication at the distance of 2 km between LoRa
	Design to flow in node red to have the sequencial reading and storing of node data in gatewqay
	Node Red Flow design for Pushing the data to Osmosis Cloud Platform with the required time Frequency.
	Use Case: Implemented in Mining Industries
	Use Case: Implemented in Industrial areas where there is no Power and Internet feasibility
Image Processing	Open CV and Deep Learning
	Python code for Facial Recognisation
	Open CV for computer vision
	Use of Numpy for facial array
	Creating a Cascade Rectangle
	Running the Output Screen to load the faces
	Comparing the images with the Output Screen Images
	Displaying the name of the Person on the output Screen
	Use Case: Facial Attendence system in Universities and Companies.
	Use Case: Facial house Security System.
	Python code for Object Detection
	Creating a Classes of the Object to be recognised.
	Using a Aurgement Martix for the Percentage of Object detection.
	Using of Object Deep Learning Tool.
IIOT	Hardware Brief Description
	UART Communication between Controller and Gateway
	Controlling & Monitoring the Status of the Motor in Cloud and HMI Dashboard
	Metal Count detection using the sensors.
	Colour Detection of the Bottles or objects and storing those count in Cloud and HMI Dashboard

	Monitoring the Temperature and Vibration of the Motor to prevent it from getting damage
	Integrated Cloud UI template for Graphical representation of IIoT data.
	Modbus Communication between PLC and Gateway
	SPI Communication between LoRa and Controller
	LWPAN communication Protocol Technology
	Sequencial Ladder logic for Programming the Digital PLC
	Node Red flow diagram for Posting the Data to Osmosis Cloud Platform using MQTT Protocol.
	Designing of Node Red HMI Dashboard for User Interface.
	IIOT kit Demo
	IIOT Applications
Thingworx	Practical1: Installing Thingworx
	Practical2: Import and Export
	Practical3: Importing Extension
	Practical4: creating Model Tags and adding Vocabulary terms
	Practical5: use case - Vending Mahcine
	Practical6: creating Thing, ThingShapes, ThingTemplates
	Practical7: creating Mashups
	Practical8: Property Bindings with Remote values
	Practical9: Configuring Events and Subscriptions
	Practical10: Creating Services, infotable and Datashapes
	Practical11: connecting to External Database MySql
	Practical12: Fetching Pi temperature,Frequency and voltage values and display into the Thingworx platform
	Practical13: Home automation with Raspberrypi and Thingworx platform.

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.
- **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.

IN359UC INSTRUMENTATION IN UNIT OPERATION LAB
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This lab course provides the knowledge of various process unit used in various chemical plant and other process plant.

COURSE OBJECTIVES:

1. To introduce the basic unit operation using instrumentation
2. To explain the working principle different unit operations in industry .

DESIRABLE AWARENESS/SKILLS:

To understand basic operation of unit operation equipment in process industries.

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand block diagram of chemical process.	01,02	Remembering, Understanding
CO2	Understand classification of unit operation.	01,02	Remembering, Understanding
CO3	Understand the process of distillation and other unit operation equipment.	01,02	Remembering, Understanding
CO4	Select suitable size reduction equipment, separation equipment and proper conveying medium	01,02	Remembering, Understanding
CO5	Apply the concepts of process control to the automation of processes	01,02	Remembering, Understanding

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	1	1	-
CO3	1	3	2	2	2	-	-	-	-	-	-	-	2	1	1
CO4	1	2	3	2	-	-	-	-	-	-	-	-	2	1	2
CO5	3	3	3	3	2	1		-	-	-	1	2	3	2	3

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

LIST OF EXPERIMENT:

Minimum Ten experiments shall be performed to cover entire curriculum of course IN359UC.
The list given below is just a guideline.
List of Experiment:

1. Study of different unit operations in process industry.
2. Study of basic operation of a distillation column .
3. Study of basic operation of evaporator.
4. Study of basic operation of dryers.
5. Study of operation of different heat exchangers.
6. Study of basic operation of crystallizers.
7. Study of Crushing and grinding equipment in any process.
8. Study of different filtration equipment in process.
9. To analyze the use of interlocks and trips as associated with these units.
10. To study different unit operation equipment in power plant.
11. To study different unit operation equipment in sugar plant.
12. To study different unit operation equipment in food process plant.

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.
- **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.

IN359U BIOMEDICAL SIGNAL PROCESSING LAB
PROFESSIONAL ELECTIVE-II

Teaching Scheme: 02 P ; Total: 02 **Credits:** 01
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

Students with a good background in Signals and Systems are prepared to take this course. This course includes introduction to the biomedical signals, analysis of the biomedical signals using signal processing techniques. Also the data reduction techniques for biomedical signals will be studied

COURSE OBJECTIVES:

6. To introduce the biomedical signal origin & dynamics
7. To give the basic knowledge of signal processing onbiomedical signals
8. To give the knowledge about events detection (viz. P, QRS and T wave in ECG)
9. To study the filtering techniques, Neurological Signal Processing techniques
10. To study the various biomedical signal Data compression techniques

COURSE OUTCOMES

After successful completion of this course, students will be able to

6. Define the origin, source and characteristics of biomedical signals,
7. Differentiate the basics of signal processing techniques
8. Demonstrate the event detection algorithms and inferences in ECG waveform
9. Demonstrate the auto regressive models for EEGwaveform signal analysis
10. Implement, categorize the data compression techniques with algorithm

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	1	2	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	1	-	2	-		-	-	-	1	2	2	2	2

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

LIST OF EXPERIMENT:

Minimum Ten experiments shall be performed to cover entire curriculum of course IN359UC. The list given below is just a guideline.
List of Experiment:

1. To Classify different signals used in biomedical signal processing
2. To plot the ECG signal from database sampled at 200 Hz and plot it.
3. Design a notch filter with two zeros to remove the artifact in ECG signal
4. Calculate the signal to noise ratio from signal and noise energy
5. Extract the specified template from PQRST waveform using matlab
6. Find the cross coorelation between specified template and ECG signal
7. Find the magnitude and phase response of the Butterworth filter
8. Filter the noisy ECG signal with Butterworth Low pass filter order 2 Cut-off frq 10
9. Remove the wandering baseline from ECG signal with derivative based filter
10. Implement the Pan Tompkins method for QRS detection from ECG signal

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.
- **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.

IN360U MINIPROJECT

Teaching Scheme: 04 P ; Total: 04 **Credits:** 02
Evaluation Scheme: 25 ICA + 25 ESE **Total Marks:** 50
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The mini project is one of the most important single piece of work 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 mini-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 organise 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 POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO3	2	3	2	3	2	-	-	-	-	-	-	-	2	2	1
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	3	2	2	1		3	-	-	1	2	2	2	2

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

Course Content

- The mini project shall be carried out in-house i.e. in the department's laboratories/centres by a group 2 – 4 students. In any case the group shall not consist of more than four students.
- The mini project shall consist of design and implementation of any suitable electronic system, sub system or circuit based on knowledge and skills previously gained.
- The mini project outline (a brief or condensed information giving a general view of mini project topic) on the selected topic should be submitted to the course coordinator for approval within one weeks from the commencement of the term.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation.
- **Mini Project Deliverables:** A mini 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/department's web site) duly signed by course coordinator and present as mini project 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 by course coordinator.
- Course coordinator shall judge the students on the principle of continuous evaluation and contribution of individual student in the group.
- It shall be evaluated on the basis of deliverables of mini project and depth of understanding.
- Course coordinator shall maintain the record of continuous evaluation in appropriate format available on institute/department's 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 mini project and depth of understanding (oral examination). It shall be evaluated by two examiners out of which one examiner shall be out of institute.

SH481U ACCOUNTS AND FINANCE FOR ENTREPRENEURS

Teaching Scheme: 02L+ 00 T; Total: 02 **Credits:** 02
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

The course is intended to provide basic understanding of accounting and finance to engineering students with the basic concept of accounting and finance. This course introduces the student to the fundamental concepts of financial management; the basic rules and principles of accounting, financial markets and sources of finance. Students will study the financial accounting, statement preparation. Students will learn leverage analysis as well as working capital management.

DESIRABLE AWARENESS/SKILLS:

Knowledge of basic accounting and finance

COURSE OBJECTIVES:

The objectives of offering this course are

1. To understand the fundamentals of financial accounting
2. To know preparation of financial statement
3. To develop the interest towards financial management
4. To create awareness about budget and budgetary control
5. To understand and solve leverage analysis and working capital management

COURSE OUTCOMES:

On the successful completion of this course; student shall

1. know the basic concept of financial accounting
2. able to demonstrate the ability to preparefinancial
3. understand and implement the fundamental concepts financial management
4. understand the budget and budgetary control
5. analyze the leverage and working capital management

Contents:

Introduction to Financial Accounting: Introduction to accounting, meaning, evolution of accounting, importance of accounting, users of financial statements, financial, cost and management accounting, accounting concepts and conventions

Financial Statement Preparation: Meaning, classification of accounts, rules and principles governing double entry, book-keeping system, meaning, preparation of journal, ledger, & trial balance, preparation of financial statement, profit & loss account, balance sheet

Budget and budgetary control: Introduction, definition of budget and budgetary control, objectives, essential requirements, advantages and disadvantages, types of budgets- cash and flexible

Introduction to Financial Management: Finance and other discipline, nature and scope of financial management, functions of financial management, objectives of the firm, sources of finance, long term sources, short term sources, international sources

Leverage Analysis and Working Capital Management: Operating leverage, financial leverage, combined leverage, working capital management: operating cycle, determinants of working capital, types of working capital, importance of working capital, components of working capital, measuring working capital requirements

Text books

1. Financial Accounting by Rajasekaran V. Pearson publications 2011.
2. Basic Financial Accounting by Karsten Wiborg, 1st edition, academica publications.
3. Financial Accounting by W. Albrecht, Earl Stice, James Stice, 11th edition, South Western cengage learning.
4. Financial Accounting by V.K. Goyal, 2nd edition, Excel books Delhi

Reference Book

1. Accounting and financial management by M.E. Thukaram Rao, New Age International publishers
2. Financial, Cost & Management Accounting by Dr. P. Pariasamy, 2014 Himalaya Publishing House
3. Financial Management by Khan & Jain, 8th edition, Tata Mcgraw Hill
4. Financial Management by Dr. P.C.Tulsian, 5th edition, S. Chand and company.
5. Financial Management by Ravi Kishore, 8th edition, Taxmann Publications Pvt. Ltd

IN452U ANALYTICAL INSTRUMENTATION

Teaching Scheme: 03L+ 00 T; Total: 03 **Credits:** 03
Evaluation Scheme: 30MSE + 10 ISA + 60 ESE **Total Marks:** 100
ESE Duration: 3 Hrs

COURSE DESCRIPTION:

This course provides the knowledge of different analytical methods used in chemical analysis and role of instrumentation in it.

COURSE OBJECTIVES:

1. To understand principles of analytical instrumental analysis.
2. To study the theory and design of analytical instruments.
3. To develop problem-solving skills applicable to real-world problems.

DESIRABLE AWARENESS/SKILLS:

Basic sensor and transducers, Instrumentation and Measurements system.

COURSE OUTCOMES:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the capabilities and limitations of analytical instruments.	01,02	Remembering, Understanding
CO2	Learn the advances in analytical instrumentation.	01,02	Understanding
CO3	Select and apply an analytical instrument in the physical, chemical and biological world.	03	Applying
CO4	Analyse and select proper instrument and appreciate the role of instrumentation for given application	03,04	Analyzing Evaluating

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	3	1	-	-	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	2	1	2	-	1	-	-	-	-	1	3	3	1
CO4	2	3	2	2	-	1	-	-	-	-	-	2	2	3	2

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

Course Content

Chemical Analysis and Analytical methods

Classification of Analytical Methods: Classical and instrumental methods, comparison of these methods, classification of instrumental methods (spectral, electro analytical and separative methods)

UV Visible and Spectroscopy: Laws of photometry, Beer and Lambert's law, monochromator. design and monochromator performance, colorimeters, single beam and double beam spectrophotometers, dual wavelength and double monochromatic systems, direct reading multichannel spectrophotometers, diode array rapid scanning spectrophotometers, reverse optics technique.

IR spectroscopy: Instrumentation, sources, detectors, FTIR. Raman Spectrometry, Raman effect, Raman spectrometer components, LASER Raman spectrophotometer Emission and Absorption Spectroscopy.

Emission Spectroscopy: Principle of emission spectroscopy, sources of excitation, DC arc, AC arc, AC spark and Plasma excitation sources, Flame photometry: Principle, instrumentation constructional details, fuel gases, atomizer, burner, optical system, recording system. Interferences in flame photometry, applications, Atomic Absorption Spectroscopy (AAS): Principle, instrumentation-hollow cathode lamps, burners and flames, plasma excitation sources, optical and electronic systems, interferences in AAS, applications.

Nuclear Magnetic Resonance (NMR) Spectrometry:

Principle, nuclear spin, nuclear energy levels, resonance condition, NMR absorption spectra, chemical shift, constructional details of NMR spectrometer, sensitivity enhancement techniques, spin decoupler, Fourier transform NMR spectroscopy;

Mass Spectrometry:

Principle and components of mass spectrometer. magnetic deflection type, time of flight, radio frequency, double focusing, quadrupole type, gas chromatograph mass spectrometer (GCMS) system resolution of mass spectrometer, applications in industry.

Electron and Ion Spectroscopy: Surface spectroscopic techniques, electron spectroscopy for chemical analysis (ESCA), Auger spectroscopy (AES), secondary ion mass spectrometry (SIMS) and ion scattering spectroscopy (ISS). Radio Chemical Instrumentation: Radio chemical methods, radiation detectors, ionization chamber, Geiger Muller counter, proportional counter, scintillation counter, semiconductor detectors, pulse height analyzer. Principle and constructional details of Electron Spin Resonance (ESR) Spectrometry.

X-ray Spectrometry:

X-ray spectrum, Instrumentation for X-ray spectrometry, X-ray diffractometers, X-ray absorption meter. X-Ray fluorescence spectrometry. Electron probe microanalyzer.

Chromatography

Chromatography: classification, Basic definitions**.** Principle and basic parts of gas chromatograph. Components of gas chromatograph like carrier gas, sample injection system, thermal compartment, temperature programming. Detectors-thermal conductivity, flame ionization, electron capture.

Liquid Chromatography: Introduction and its classification, HPLC, Applications of Chromatographs in industries such as process, food and pharmaceuticals.

Text Books:

1. Handbook of Analytical Instruments by R.S. Khandpur, Second ed., 2006. Tata McGrawHill.
2. Instrumental Methods of Analysis by Willard, Merritt, John Aurie Dean, CBS Publishers & Distributors, New Delhi, Seventh ed., 1988.
3. Instrumental Methods of Chemical Analysis by B. K. Sharma, Goyal publications house Meerut , 23th edi., 2004.

Reference Books:

1. Principles of Industrial Instrumentation by D. Patranabis, second edition, Tata McGraw
2. Instrumental Methods of Chemical Analysis by G. W. Ewing, 4th Edi, McGraw Hill, 1975.
3. Analytical Instrumentation Handbook by Bela G Liptak, Chilton, Second ed., 1994.
4. Principles of Instrumental Analysis by Skoog, Holler, Nieman, Thomson books-cole publications, Sixth ed., 2006.