INSTRUMENTATION AND CONTROL ENGINEERING

T.Y. B. Tech.
Effective from A. Y. 2013-14

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List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	DEC	Departmental Elective Course
2	PCC	Program Core Course
3	LC	Laboratory Course
4	HSSC	Humanities and Social Science Course
5	MLC	Mandatory Learning Course
6	LLC	Liberal Learning Course
7	OEC	Open Elective Course
8	SEC	Science Elective Course
9	BSC	Basic Science Course

Mission and Vision of the department

Vision:

To be a dynamic contribution or to the global community through the development of expertise and dissemination of advance knowledge in the field of Instrumentation and Control and to create an environment that will facilitate the growth of individuals through innovative teaching, research and involvement of industry.

Mission:

- ✓ To provide high quality undergraduate and prost graduate programs in Instrumentation and Control Engineering.
- ✓ To advance knowledge of Instrumentation and Control Engineering, strengthen and support R and d organizations/institutions, industry and enhance teaching.
- ✓ To work on socially relevant issues/problems, issues/problems of national importance

Program Education Objectives (PEOs):

1. To provide the students with solid foundation in mathematics, science and Instrumentation Engineering to solve real world problems appropriate to the discipline.
2. Be able to apply current industry accepted practices, new and emerging technologies to analyze, design, implement, and maintain state-of-art solutions.
3. Exhibit self- learning capabilities to assimilate and practice emerging theories and technologies. Exhibit teamwork and effective communication skills.
4. To inculcate professional and ethical attitude and ability to relate automation issues to society at large.
5. Be successfully employed or accepted into a graduate program / higher studies, and demonstrate a pursuit of lifelong learning.

Program Outcomes (POs):

On successful completion Graduates will demonstrate:

a. An ability to apply knowledge of mathematics, Science and Engineering to Instrumentation and Control Discipline
b. An ability to design and conduct experiments for measurement, measurement devices / elements, Control System, variety of control algorithms paradigms, final control elements, etc., and ability to analyse and interpret data.
c. Be able to apply the principles and practices for instrument / system / equipment / device design and development to real world problems adhering to safety and regulatory standards as applicable.
d. Be able to work effectively in a various team (may be multidisciplinary teams).
e. An ability to identify, formulate and solve a problem in Instrumentation and Control Engineering
f. Understand the social impact of automation, safety aspects of automation, hazards associated with various processes, environmental issues, professional ethics, etc.
g. An ability to communicate effectively in oral and written form while formulating project proposals, reports and other related documents.
h. Understand the impact of Instrumentation and Control solutions in a global, economic, environmental, and societal context.
i. Demonstrate the knowledge and capabilities necessary for pursuing a professional career or graduate studies; recognize the need for continuing professional development.
j. Understanding of contemporary and emerging technology for various processes and systems.
k. Ability to select and use latest hardware and software tools for various processes and systems.
l. Demonstrate an understanding of sensors / transducers, Control system, complete automation system.
m. Demonstrate proficiency in using a high-level / low level programming languages and network protocols for embedded system applications and networked systems.

CURRICULUM STRUCTURE OF T. Y. B.TECH (Instrumentation & Control)

Effective from Academic Year 2013-2014

I-Semester:

Sr. No	Course Type/Code	Subject Title	Contact hours			Credits
			L	T	P	
01	DE/IE	*Department Elective	3	--	--	3
02	PCC/IE-09002	Process Plant Operations	3	--	--	3
03	PCC/IE-09001	Microcontroller Techniques and its Applications	3	--	--	3
04	PCC/IE-09004	Control System Design	3	--	--	3
05	PCC/IE-09005	Control System Components	2	--	--	2
06	LC/IE-09006	Numerical Methods Laboratory	--	--	3	2
07	LC/IE-09007	Microcontroller Techniques and its Applications Laboratory	--	--	3	2
08	LC/IE-09009	Control System Design Laboratory	--	--	3	2
09	LC/IE-09008	Control System Components Laboratory	--	--	3	2
10	HSSC/AS-09002	Humanities Course	2	--	--	2
		Total	**16**	**0**	**12**	**24**

*Department Elective: Signals and Systems

II-Semester:

Sr. No	Category of Course	Subject Title	Contact hours			Credits
			L	T	P	
01	OEC/SEC	Open Elective/Science Elective Refer to Annexure I	3	-	-	3
02	PCC/IE -09010	Process Loop Components	3	-	-	3
03	PCC/IE - 09011	Digital Signal Processing	3	-	-	3
04	PCC/IE - 09012	Instrument and System Design	3	-	-	3
05	PCC/IE - 09013	Analytical Instrumentation	3	-	-	3
06	LC/IE - 09014	Process Loop Components Laboratory	-	-	3	2
07	LC/IE - 09015	Digital Signal Processing Laboratory	-	-	3	2
08	LC/IE - 09016	Instrument and System Design Laboratory	-	-	2	1
09	LC/IE - 09017	Analytical Instrumentation Laboratory	-	-	2	1
10	LLC/LL-09001	Refer to Annexure II	1	-	-	1
11	MLC/ML-09001	Constitution of India	2	-	-	2
		Total	**18**	**0**	**10**	**24**

DE-09024 Signals and Systems

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks:Continuous evaluation-Assignments/Quiz-40 Marks,
End-Sem Exam- 60 Marks

Unit 1 **(8 hrs)**

Introduction to Signals and Systems:
Introduction to Signals, Classification of Signals, Continuous Time and Discrete Time Signals, Step and Impulse Functions, Transformation of Independent Variable. Introduction to Systems, Classification of Systems, Properties of Systems, Normal Form of System Equation, Initial Conditions, Impulse Response of a Physical System, Introduction to Convolution, System Impulse Response

Unit 2 **(6 hrs)**

Analysis of Systems:
System characteristics, Convolution Sum, Sampling theorem, reconstruction, aliasing, sampling in the frequency domain, sampling of discrete time signals, decimation and interpolation

Unit 3 **(6 hrs)**

Z-Transform:
Definition, properties of z-transform, z-transform of standard sequences, inverse Z-transform, relationship of z-transform with fourier transform, applications of Z-transform to solutions of difference equations, Properties and applications of Z transform

Unit 4 **(6 hrs)**

Fourier Transform Analysis:
Fourier analysis for Continuous time signals and systems, Continuous time Fourier series and its convergence, Continuous time Fourier Transform, its properties, frequency response

Unit 5 **(8 hrs)**

Frequency Response Characteristics of LTI system:
Frequency response of a system to complex exponential and sinusoidal signals, steady state and transient response to sinusoidal inputs signals, computation of frequency response functions. Design of LTI systems as frequency selective filters. Finite Impulse Response, Infinite Impulse response filter structures for FIR filters: direct, cascade, frequency sampling and lattice. Structure of IIR filters: direct, cascade, parallel, lattice. Effect of finite word length in Digital filters

Unit 6 **(8 hrs)**

Discrete Fourier Transform:
Discrete time Fourier series and its convergence, Discrete time Fourier Transform, its

properties, frequency response. Introduction to DFT in time domain and frequency domain. Filtering: Ideal frequency selective filters, Non Ideal frequency selective filters, examples, Butterworth filters

Text Books:

- Michael J. Robert, "Introduction to Signals and Systems", TMH, Second ed., 2003.
- Murray R Spiegel, John Schiller and R Alu Srinivasn, "Probability and Statistics", Scaum's Outline TMH, Fourth ed., 2010.

Reference Books:

- Alan V Oppenhein, Alan S Wiilsky, "Signals and systems" PHI, Second ed. 2009.

Outcomes:

- Ability to discuss properties & representation of discrete and continuous signals
- Ability to distinguish sample process & analyze discrete system using z transform
- Ability to hypothesis discrete time system

IE - 09002 Process Plant Operations

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	100 marks:Continuous evaluation-Assignments/Quiz-40 Marks, End-Sem Exam- 60 Marks

Unit 1 **(6 hrs)**

Introduction:
Different physical and chemical laws. Basic concepts and principles of commonly used unit operation with processes, study related to different process industries with some examples of Distillations, extraction, humidification. Basic concepts of corrosion and protection from corrosion. Selection materials, metals & alloys used in construction of field instruments for different applications

Unit 2 **(6 hrs)**

Fluid transportation operations and equipments:
Basic concepts of fluid transportation operations, different means of fluid transportation. Basic concepts, specifications and working of pumps, compressors, fans, blowers. Selection of equipments and its material for different applications

Unit 3 **(8 hrs)**

Heat transfer Operations:
Concepts of Energy balance, heat transfer coefficients. Basic principles, working and selection criteria for double pipe, shell & tube heat exchangers, boilers, condensers, evaporators, cooling towers. Role of kinetics, types of reactors, types of reaction/reactors, biochemical reactions commonly encountered in chemical process industries, Role of thermodynamics

Unit 4 **(8 hrs)**

Mass transfer Operations:
Material balance with or without chemical reactions mass transfer coefficients. Principles , working , process & mechanical design considerations for equipments used for unit operations like distillation, extraction, drying, humidification, dehumidification, absorption, filtration, sedimentation

Unit 5 **(6 hrs)**

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. Laws of commutation forced and hindered setting. Working of forth floatation, hydro cyclones, jigging and concentration equipment.

Unit 6 **(8 hrs)**

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

Text Books:

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

Reference Books:

- Bela G Liptak, "Instrument Engineers Handbook: Process Control" Pearson Education, Third ed., 1985.

Course Outcomes:

- Acquire knowledge of unit operations and effect of other parameters on them. [PEO1][PO-b]
- Understand instrumentation and control related with the unit operations. [PEO2][PO-f]
- Identify of unit operations used in different industries [PEO2][PO-j]

IE - 09001 Microcontroller Techniques and Its Applications

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks:Continuous evaluation-Assignments/Quiz-40 Marks,
End-Sem Exam- 60 Marks

Unit 1 **(8 hrs)**

Microcontroller Basics:
Difference between microprocessor and microcontroller, architectural considerations, CPU, memory sub system, I/O sub system, control logic. Architecture of MCS-51 microcontroller. Memory structure, different registers (SFR's), addressing modes. Timing Diagram.

Unit 2 **(8 hrs)**

Programming:
Concept of assembler directives, editor, linker, loader, debugger, simulator, emulator. Instruction set, basic programming using 8051 instructions. Introduction to embedded-C, Integrated Development Environment (IDE), cross compiler, ISP, simple program for delay generation.

Unit 3 **(6 hrs)**

I/O Programming:
I/O programming, interfacing with simple switch, LED. Seven segment interfacing techniques. Programming with alphanumeric LCD and matrix keypad.

Unit 4 **(8 hrs)**

On-Chip Peripheral Interfaces:
Programming with on-chip Timers, Counters, UART, RS485 transceiver. I2C and SPI protocols. Interrupts, interrupt execution sequence, programming with software and hardware interrupts.

Unit 5 **(6 hrs)**

External Interfaces:
Analog to digital convertor, interfacing with external serial and parallel ADC's, Digital to analog convertor (DAC), interfacing with DAC, Interfacing with stepper motor and DC motor.

Unit 6 **(6 hrs)**

RISC Microcontrollers, introduction to AVR series microcontrollers. Introduction to ARM7 microcontroller (LPC2148).

Text Books:

- Mohammad Ali Mazidi, "The 8051 Microcontroller and Embedded System: Using Assembly and C", Pearson education, Second ed., 2006.
- Kenneth J. Ayala, "8051 Microcontroller: Programming, Architecture and Interfacing", Thomas Delmar Learning, Third ed., 2007.

Reference Books:

- INTEL Manual: MCS-51 Architecture.
- Philips Data Handbook, "I2C Peripherals".
- IEEE Standards, "Low Rate Wireless Personal Area Networks", 2003.
- Jan Axelson, "USB Complete", Penram International Publishing House, First ed., 1998.

Course Outcomes:

- Understanding the basic principles of Microcontroller based design and development. [PEO2][PO-m]
- Ability to design and build a functional prototype for real world applications. [PEO2][PO-c]
- To encourage the students to have a better understanding on state-of-the-art interfacing technologies, their potential applications and their market views. [PEO2][PO-m]
- Ability to undertake problem identification, formulation and selection of appropriate Microcontrollers. [PEO1][PO-e]
- To test whether students can apply their knowledge of fundamentals of Microcontrollers, programming and interfacing technology to solve and design simple engineering problems. [PEO1][PO-a]

IE - 09004 Control System Design

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks:Continuous evaluation-Assignments/Quiz-40 Marks,
End-Sem Exam- 60 Marks

Unit 1 **(7 hrs)**

State space:
General state space representation, converting state space to transfer function and vice versa controller design introduction, design with state feedback, controller design by Ackerman's formula

Unit 2 **(8 hrs)**

Controller and observer design:
Pole placement, solving pole placement with MATLAB, Controllability, different

approaches for controller design, Introduction to observer , full order and reduced order observer, observability, different approaches for observability design.

Unit 3 **(7 hrs)**

Design of controller with root locus:
transient response via gain adjustment, improving time domain specifications (steady state error, transient response) by cascade compensation, feedback compensation

Unit 4 **(8 hrs)**

Controller design:
Design of Proportional (P), Integral (I), Derivative (D), PI, PD, PID controllers, lead, lag, lead-lag controller by root locus method

Unit 5 **(6 hrs)**

Design of controller in frequency domain:
Design of controller with bode plot: improvement of steady state and transient response with lead, lag, lead lag compensator design

Unit 6

(6 hrs)

System uncertainties and disturbances:
Effect of uncertainties and disturbances on system performance, uncertainty and disturbance estimation, Effect of uncertainties and disturbances on controller and observer design, effect of measurement noise and un- modeled dynamics.

Text Books:

- Norman Nise, "Control System Engineering", Wiley India, Fifth ed., 2009.
- K. Ogata," Modern Control Engineering", PHI, Fifth ed., 2009.

Reference Books:

- G. C. Goodwin, S. F. Graebe, M. E. Salgado; "Control System Design", PHI, First ed. 2002.
- Friedland, "Control System Design", Dover Publication, First ed., 2005.

Course Outcomes:

- An ability to design output feedback controller in state space [PEO1] [PO-l]
- Ability to design full state observer [PEO1] [PO-e]
- Ability to design lead, lag, lead-lag compensators [PEO1] [PO-l]
- Ability to model hydraulic, pneumatic, thermal systems [PEO1] [PO-e]

IE - 09005 Control System Components

Teaching Scheme

Lectures : 2 hrs/week

Examination Scheme

100 marks:Continuous evaluation-Assignments/Quiz-40 Marks,
End-Sem Exam- 60 Marks

Unit 1 **(6 hrs)**

Motors:
Types, working principle, characteristic, and mathematical model of following:
Motors AC/DC motors, stepper, servo, linear, Synchronous, Generators, and Alternator

Unit 2 **(6 hrs)**

Types, working principle, characteristics, and symbolic representation of following:
Switches: Toggle, Slide, DIP, Rotary, Thumbwheel, Selector, Limit, Proximity, Combinational switches, zero speed, belt sway, pull cord.
Relays: Electromechanical, Solid state relays, relay packages
Contactors :Comparison between relay & contactor, contactor size and ratings
Timers : On Delay, Off delay and Retentive

Unit 3 **(8 hrs)**

Sequencing & Interlocking for motors:
Concept of sequencing & Interlocking, Standard symbols used for Electrical Wiring Diagram, Electrical Wiring diagrams for Starting, Stopping, Emergency shutdown, (Direct on line, star delta, soft starter) Protection devices for motors: Short circuit protection, Over load Protection, Over/ under voltage protection, Phase reversal Protection, high temperature and high current Protection, over speed, Reversing direction of rotation, Braking, Starting with variable speeds, Jogging/Inching
Motor Control Center: Concept and wiring diagrams

Unit 4 **(8 hrs)**

Pneumatic components:
Pneumatic Power Supply and its components: Pneumatic relay (Bleed & Non bleed, Reverse & direct), Single acting & Double acting cylinder, Special cylinders: Cushion, Double rod, Tandem, Multiple position, Rotary Filter Regulator Lubricator (FRL), Pneumatic valves (direction controlled valves, flow control etc), Special types of valves like relief valve, pressure reducing etc.
Hydraulic components:
Hydraulic supply, Hydraulic pumps, Actuator (cylinder & motor), Hydraulic valves

Text Books:

- B. L. Theraja, "A text book of Electrical Technology", S. Chand & Company Ltd.,

Vol II First ed. 1959.
- S. R. Majumdhar, "Pneumatic Systems", Tata McGraw-Hill Publisher, 2009.

Reference Books:

- Meixner H and Sauer E, "Intro to Electro-Pneumatics", Festo didactic, First ed. 1989.
- Hasebrink J P and Kobler R, "Fundamentals of Pneumatic Control Engineering", FestoDidactic: Esslinger(W Germany),1989.
- Petruzella, "Industrial Electronics", McGraw-Hill International First ed., 1996.

Course Outcomes:

- Ability to select and use the components for electrical systems [PEO1][PO-c]
- Ability to identify, formulate and solve a problem using pneumatic system in instrumentation and control engineering [PEO1][PO-e]
- Ability to identify, formulate and solve a problem using hydraulic system in instrumentation and control engineering [PEO1][PO-e]

IE - 09006 Numerical Methods Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 3hrs/week	Term-work: 50 Marks Practical Exam- 50 Marks

WRITE DOWN AND EXECUTE THE FOLLOWING PROGRAMS USING C/C++/MATLAB

1. Roots of Non-Linear Equations-To find the roots of non-linear equations using Bisection method.
2. Roots of Non-Linear Equations -To find the roots of non-linear equations using Newton-Raphson method.
3. Interpolation- Using Linear or Quadratic interpolation, finds intermediate data points from given set of data.
4. Interpolation- Using Lagrange interpolation, find intermediate data point form given set of data and compare the result with linear or quadratic interpolation
5. Curve Fitting- For a give data set; find best fit curve using linear regression.
6. Curve Fitting- For a give data set; find best fit curve using polynomial regression.
7. Linear Solver-To solve system of linear equations using Gauss Elimination method.
8. Linear Solver-To solve system of linear equations using Gauss Jordan method.
9. Integration-To integrate numerically using Trapezoidal Rule
10. Integration-To integrate numerically using Simpson's Rule
11. Matrix Eigen values-To find Eigen values of matrix by power method
12. Differential Equation-To find numerical solution of ordinary differential equations by Euler's method
13. Differential Equation-To find numerical solution of ordinary differential equations

by Runge- Kutta method

Course Outcomes:

- Be familiar with the use of numerical methods in modern scientific computing
- Be familiar with finite precision computation
- Be familiar with numerical solutions of nonlinear equations in a single variable
- Ability to determine different methods of numerical interpolation and approximation of functions
- Be familiar with numerical integration and differentiation
- Ability to give the solution of ordinary differential equations through different methods
- Be familiar with calculation and interpretation of errors in numerical methods

IE - 09007 Microcontroller Techniques and Its Applications Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 3hrs/week	Term-work: 50 Marks Practical Exam- 50 Marks

Students have to perform minimum 16 experiments using following embedded platforms:
1. Twelve experiments using8051 microcontrollers (MCS-51 series microcontrollers).
2. Two experiments using Arduino board (AVR series Microcontroller).
3. Two experiment using LPC 2148 board (ARM 7 series microcontroller)
Case study: Course project using above interfacing techniques.

Course Outcomes:

- Ability to develop, design and debug of low-level and high level language of 8051 based microcontroller with basic interfacing techniques on different interfacing devices [PEO1][PO-a]
- Ability to identify, and select an appropriate microcontroller as well as development tools for given applications [PEO1] [PO-e]
- Ability to function effectively as an individual and in teams, with the capacity to be a leader or manager as well as an effective team member [PEO1][PO-k]

IE - 09009 Control System Design Laboratory

Teaching Scheme

Practical: 3hrs/week

Examination Scheme

Term-work: 50 Marks

Practical Exam- 50 Marks

Students have to perform minimum 12 experiments in MATLAB environment and validate in real time domain.

List of Experiments:

1. Find state transition matrix from a given system dynamic
2. Design an observer for a given system by using state space method.
3. Validation of observer design on QUBE (position and speed control).
4. Design state feedback controller for a given system.
5. Validation of controller design on QUBE (position and speed control)
6. Design controller by adjusting gain for a given system by using root locus method.
7. Validation of controller design on QUBE (position and speed control).
8. Design controller for improving transient and steady state response by root locus method.
9. Design of PID controller.
10. Validation of PID controller design on QUBE (position and speed control).
11. Design of lead controller to satisfy given specifications using bode plot.
12. Design of lag controller to satisfy given specifications using bode plot.
13. Design lag-lead controller to satisfy given specifications using bode plot.
14. Validation of lag-lead controller design on QUBE (position and speed control).
15. Study effect of uncertainty and disturbance on system performance.
16. Design of uncertainty and disturbance method and validate on QUBE.

Course Outcomes:

- Design of pole placement controller and validation on MATLAB platform. [PEO1] [PO-a]
- Design of observer and validation of controller design using designed observer states on MATLAB platform. [PEO1] [PO-l]
- Design PID controller and validate on MATLAB platform. [PEO2] [PO-k]
- Design Lead-Lag compensator and validation on MATLAB platform [PEO1] [PO-l]

IE - 09008 Control System Components Laboratory

Teaching Scheme

Practical: 3hrs/week

Examination Scheme

Term-work: 50 Marks

Practical Exam- 50 Marks

List of Experiments

1. Study of symbols used in electrical wiring diagram
2. Study of electromagnetic relay and solid state relay
3. Wiring diagram for logic function AND/OR/NOT
4. Wiring diagram for DOL/ Star-delta starter
5. Study of Pneumatic system components
6. Build pneumatic circuit to operate single acting and double acting cylinder.
7. Build pneumatic circuit to operate double acting cylinder using AND and OR function
8. Build of Pneumatic circuit for speed control of a cylinder.
9. Build pneumatic circuit to operate double acting cylinder using time delay function
10. Study of hydraulic system components
11. Build hydraulic circuit to operate double acting cylinder
12. Build hydraulic circuit to operate double acting cylinder using electro hydraulic Components.

Course Outcomes:

- Characterize performance of motor. [PEO2] [PO-c]
- Implement electrical circuits for motor operation. [PEO1] [PO-e]
- Implement pneumatic circuits to solve a problem. [PEO1] [PO-e]
- Implement hydraulic circuits to solve a problem. [PEO1] [PO-e]

AS - 09002 Humanities Course/Applied Psychology

Teaching Scheme	**Examination Scheme**
Lectures : 2 hrs/week	100 marks:Continuous evaluation-Assignments/Quiz-40 Marks, End-Sem Exam- 60 Marks

Unit 1 **(4 hrs)**

Introduction to Psychology:
Definition, Nature and Aims, Counseling, Industrial and Social Psychology, Creativity and its application.
Mind Mapping and Problem Solving, Self Awareness, Johari window.

Unit 2 **(6 hrs)**

Personality:
Carl Jung's type theory, Bandura's Social learning, Big Five model Indian Perspective on Personality- Panchakosh Model, SWOT analysis, life planning, emotional intelligence

Unit 3 **(8 hrs)**

Organizational Behaviour:
Behaviour at workplace (personality, attitude and perceptions), Motivation, Job satisfaction, Leadership and Group dynamics, Engineering Psychology (Ergonomics), Man-machine relation, Group dynamics, Transactional analysis

Unit 4 **(4 hrs)**

Stress Management:
Nature, types and causes of stress, General Adaptation Syndrome (GAS), Coping with Stress- Cognitive, Emotional, and Behavioural techniques, Type A and B theory.

Text Books

1. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. (2001). *Introduction to Psychology*. 7th Edition. New Delhi: Tata McGraw Hill
2. Schultz, D. & Schultz, S. E. (2002). *Psychology and Work Today*. 8th Edition. Pearson Education

Refrence Books

1. Hilgard, E. R., Atkinson, R. C., Atkinson, R.L. (1975). *Introduction to Psychology*. 6th Edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
2. Golman, Daniel. (1998). *Working with Emotional Intelligence*. Bloomsbury Publishing Plc.
3. Matthewman, L., Rose, A., & Hetherington, A. (2009). *Work Psychology*. Indian Edition. Oxford University Press.

Practical work

Teaching Scheme
Practical : 2 hrs/week

Examination Scheme
Term Work: 50 Marks
Oral : 50 Marks

List of Experiments:

1: Self Awareness (20 Marks) **(4 hrs)**

Aims/Objectives for the Year- Newspaper Activity, SWOT analysis, Personal Effectiveness Scale, Johari Window.

2: Level of Adjustment (10 Marks) **(6 hrs)**

Adjustment Inventory By M.L. Saxena, Interpretation and Explanation

3: Stress and Personality (15 Marks) **(8 hrs)**

Student's Stress Scale by Dr. Manju Agrawal, Type A- B theory and test, Interpretation and Explanation

4: Emotional Quotient (05 Marks) **(4 hrs)**

Concept of EQ, EQ test by N.K.Chadha, Interpretation and Explanation

Course Outcomes:

- Students use Self awareness techniques for understanding their own personality

and learn to apply these techniques in everyday life
- Students understand the concept of Emotional Intelligence and learn to enhance interpersonal relationship
- Students learn time management skills and understand the importance of planning in their life
- Students learn effective study skills and use of creativity in their overall learning process
- Analysis their stress patterns and learn different ways of coping with stress

OEC Industrial Automation

Teaching Scheme
Lectures : 4 hrs/week
Tutorial : ----

Examination Scheme
100 marks:Continuous evaluation-Assignments/Quiz-40 Marks,
End-Sem Exam– 60 Marks

Unit 1 **(6 hrs)**

Basics of Automation
Introduction and evolution of Automation, Feedback and feed forward systems, Hierarchical levels of automation, introduction to plant automation.

Unit 2 **(10 hrs)**

Transmitters and converters
Introduction to transmitters, Types, working principle and block schematic, standards in Instrument signals, 2 wire, HART, Foundation Field bus transmitters, connection diagram and installation practices, maintenance, trouble shooting and calibration of transmitters, I/P converter, P/I converter working principle and calibration procedure.

Unit 3 **(8 hrs)**

Control Valves
Necessity and types of valves used in Industries, working principle of pneumatically operated control valve and motorized control valve, specifications of the control and brief description about the maintenance and trouble shooting of these valves.

Unit 4 **(6 hrs)**

Programmable Logic Controller (PLC)
Necessity and working principle along with block schematic of PLC, Programming languages, basic instruction for programming like bit, Arithmetic file and Mathematical. Demonstration of PLC functioning and development of ladder for sequencing of motors, tank level control, ON-OFF temperature control.

Unit 5 **(8 hrs)**

Application of PLC in major industries

Project life cycle, working and automation of pump house, Motor Control Centre (MCC), elevator, reactor, and bottle filling using the ladder diagram. Introduction to SCADA and HMI.

Unit 6 **(6 hrs)**

Advances in Automation
Distributed Control System, Plant wide automation, web enabled plants, communication and data transfer issues, wireless technology, advances in process control.

Text Books

- W. G. Andrew and H. B. Williams, "Applied Instrumentation in the process Industries", Volume I, Gulf Publishing Company,2/e
- Garry Dunning , "Programmable Logic Controllers " PHI Pub, 3/e

Reference Book

- James W. Hutchinson, "Control Valve Handbook", Instrument Society of America. 1/e

Course Outcomes:

At the end of this course students will demonstrate the ability to:

i. Gain knowledge of Industrial Automation basics. [PEO5][PO-i]

ii. Select control components for given application. [PEO2][PO-c]

iii. Describe contemporary / emerging technology for various applications. [PEO2][PO-j]

IE - 09010 Process Loop Components

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks:Continuous evaluation-Assignments/Quiz-40 Marks,
End-Sem Exam- 60 Marks

Unit 1 **(8 hrs)**

Fundamentals of Process Control & Transmitters:
Elements of process control loop, concept of process variables, set point, controlled variable, manipulated variable, load variable. Representation of process loop components using standard symbols (basic with reference to control loop), and Examples of process loops like temperature, flow, level, pressure etc. Need of transmitter (concept of field area & control room area), Need for standardization of signals, current, voltage and pneumatic signal standards, concept of live & dead zero,

Signal conditioning (analog & digital) for RTD, T/C, magnetic flow meter, DPT, span & zero adjustment, Two wire transmitter, Electronic and pneumatic transmitters Electronic Differential Pressure Transmitter: Types, mounting (Installation), manifolds, calibration setup, Application of DPT for level measurement, Zero elevation, Suppression. SMART transmitter: Comparison with conventional transmitter, Block schematic. Converters: Difference between converter & transmitter, Pneumatic to current converter, Current to pneumatic converter

Unit 2 **(6 hrs)**

Types of control actions: Discontinuous:
ON/OFF, Continuous: Proportional, integral, derivative, proportional-Integral, Proportional- Derivative, Proportional-Derivative-Integral, Anti-reset windup, Rate before reset Concept of bump less transfers in PID controller, Effect of process Characteristics on PID combination, control actions for various processes

Unit 3 **(6 hrs)**

Tuning of controller:
Quarter Amplitude Decay Ratio, Loop disturbance, optimum control, Measure of quality, stability criteria
Tuning methods: Process Reaction Curve (open loop), Ziegler Nichols (closed loop), set point tuning Vs load disturbance tuning. PID with limitations (offset, saturation in D, & reset windup) rate before reset, PID variations & tuning, digital controller (position & velocity algorithms, effect of sampling time).Digital PID controllers: concept of velocity & position algorithm, block schematic of series and parallel combinations.

Unit 4 **(8 hrs)**

Programmable Logic Controller (PLC):
Continuous versus Discrete Process Control, ladder diagram using standard symbols, Architecture of PLC, Types of Input & Output modules (AI, DI, AO, DO), wiring diagram, Interfacing pneumatic & Hydraulic systems, Fixed & Modular PLC (Rack, Slot, Grouping), Specifications, manufacturers, PLC ladder diagram and instructions, PLC Programming for process applications.

Unit 5 **(8 hrs)**

Control valve:
Necessity, comparison with other final control elements, Classification of control valves based on: Valve body. Construction, type of actuation, application etc. Construction, Advantages, Disadvantages & applications of Globe: single, double, 3way, angle, Gate, Needle, Diaphragm, Rotary valves, Ball, Butterfly.
Types of actuators: Construction, Advantages, Disadvantages & applications: Spring Diaphragm, Piston cylinder (power cylinder), Pneumatic, Hydraulic, Electro-hydraulic, Electric, and smart actuators. Control valve terminology: Range ability, turndown, valve capacity, Air to open, Air to close, valve gain etc. Control valve characteristics: Inherent & installed Control valve accessories. Positioners: Application/Need, Types, Effect on performance of control valves. Volume boosters, Pressure Boosters, Reversing relay, Solenoid valves, Air lock, position indicating switches, Electro pneumatic converter, Hand wheel.

Unit 6 **(6 hrs)**

Explosion Proof Housing, Encapsulation, Sealing, & Immersion, Purging systems Hazardous area classification & intrinsic safety, Concept of safety cycle, HAZOP, fault tolerance and safety integrity level

Text Books:

- Curtis Johnson, "Process Control and Instrumentation Technology, Prentice-Hall of India Fourth ed., 1997.
- Gary Dunning, "Introduction to Programmable Logic Controller", Cengage Learning India Pvt. Ltd., Third ed., 2006.

Reference Books:

- E. B. Jones , "Instrument Technology", Butterworth's, Forth ed., 1985
- A.B. Corripio, "Tuning of Industrial Control System", ISA, Second ed., 2001
- William Andrews, "Applied Instrumentation in Process Industries", Gulf, Second ed., 1979.
- Control Valve Handbook, Fisher Controls International, Inc. Third ed., 2001.
- Norman A. Anderson, "Instrumentation for Process Measurement and Control", CRC Press, Third ed., 1980.
- B. G. Liptak, "Process Control, Instrument Engineering Hand book", Chilton Book Company, Third ed., 1995.

Course Outcomes:

- Configure of transmitters, convertors. [PEO1][PO-l]
- Select of transmitter, convertor and final control element. [PEO2][PO-c]
- Demonstrate PLC programming skill for industrial application. [PEO1][PO-m]

IE - 09011 Digital Signal Processing

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks:Continuous evaluation
Assignments/Quiz-40 Marks,
End-Sem Exam- 60 Marks

Unit 1 **(6 hrs)**

Digital Signal Processor:
Harvard architecture and modified Harvard architecture. Introduction to fixed point and floating point DSP processors, architectural features, Computational units, bus

architecture and memory architecture, data addressing, address generation unit, program control, program sequencer, pipelining, interrupts, features of external interfacing, on-chip peripherals, hardware timers, host interface port, clock generator, SPORT

Unit 2 **(8 hrs)**

Programming of DSP Processor Addressing modes, Instruction set, Programming tools such as DSP Assembler, IDE environments like CCS for DSP chip or visual DSP for Analog DSP chips, programming using DSP processor, I/O Programming

Unit 3 **(8 hrs)**

Finite Impulse Response Filters Introduction to finite impulse response filters, linear phase filters, symmetric & anti –symmetric filters, Design of FIR filter: windowing method, analysis of different types of windows, frequency sampling method, optimal equi-ripple, FIR differentiators

Unit 4 **(8 hrs)**

Infinite Impulse Response Filter Introduction to Infinite Impulse Response filter, Butterworth, Chebyshev approximation. Design of IIR filters: Impulse invariant method, bilinear transformation, approximation derivative method, IIR filters design using least square method: Pade approximation. Frequency transformations: low pass to high pass, band pass, band reject

Unit 5 **(6 hrs)**

Changing the sampling rate, Down sampling, Up sampling, Fractional rate changes, Noble identities, Polyphase Decomposition Narrowband filter banks, Delay Systems, Integer sampling rate converters, Rational sampling rate converters, Multirate filter realization structures, subband processing

Unit 6 **(6 hrs)**

Formal definition , Wavelet transform ,Basic idea, Wavelet compression, Comparison with wavelet transformation, Fourier transformation and time-frequency analysis, Continuous wavelet transform, Discrete wavelet transform, Complex wavelet transform, Dual wavelet

Text Books:

- Proakis, Manolakis, "DSP Principles, algorithms and applications-, Pearson, Fourth ed., 2009.
- Oppenheim and Schafer, "Discrete time signal processing", Pearson Publication, Second ed., 2007.

Reference Books:

- TMS320C67XX DSP Reference set, Vol. 2 1999.
- P. Lapsley, J. Bier, A. Shoham, E. A. Lee, "DSP processor fundamentals:

Architecture and features", IEEE Press, 1997.
- Rulpph Chassaing, "DSP and Applications with TMS320C673 & TMS320C716", Wiley IEEE, Second ed.
- A Antoniou, "DSP filter analysis and Design", McGraw Hill, 1979.
- Avtarsingh, S. Srinivasan, "DSP Implementation using DSP microprocessors with examples" from TMS320C54XX", 2004.

Course Outcomes:

- Apply the various programming techniques on DSPs. [PEO2,PO-a,k]
- Design FIR and IIR filters using different techniques. [PEO1,PO-e]
- Determine the frequency, steady state and transient response of LTI systems.[PEO1,PO-a,e]
- Apply the DFT and FFT methods for various signals and determine their frequency response.[PEO1,PO-e]

IE - 09012 Instrument and System Design

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation Assignments/Quiz-40 Marks,
End-Sem Exam- 60 Marks

Unit 1 **(8 hrs)**

Basic Concept of Instrumentation Design, Needs Analysis :with respect to systems deployed in; Medical, Industrial, Test and Measurement, Home Appliances, Military Functional requirements & Specifications, Impact on the design due to adverse Electrical, Thermal and Mechanical Operational Environments

Unit 2 **(8 hrs)**

Noise Sources, Electrical, Magnetic, RF, Static, Ground Loops, Shielding, near and far field, shielding effectiveness, absorption and reflection loss, shielding with magnetic material, contact protection, glow and arc discharges, loads with high inrush current, Inductive and resistive load contact protection networks for inductive loads, intrinsic noise sources

Unit 3 **(6 hrs)**

ESD, inductive charging human body model, ESD protection in equipment, software in ESD protection ,Sensitive devices, input filters, clamping suppressors

Unit 4 **(8 hrs)**

Electronic design guideline Noise in electronic circuits. Capacitive and inductive coupling

and effect of shield, shielding to prevent magnetic radiation, co-axial and twisted pair cable, grounding, safety ground, signal ground, single and multi point ground, Hybrid ground, grounding of cables shields, Ground loops and low frequency and high frequency analysis of common mode signals, guard shields

Unit 5 **(6 hrs)**

Enclosure Design Guidelines. NEMA, DIN, BSI, ANSI standards Index protection (IP), cable design guidelines; Printed circuit board design guideline, layout scheme, grid systems, PCB size, Design rules for digital circuits, and Design rules for analog circuits, single and multilayer PCB, CE / Underwrites Laboratories (UL) Compliance

Unit 6 **(6 hrs)**

Reliability, bath tub curve, Reliability for series parallel system, MTTF, MTTR, MTBF, availability, Redundancy and stand by systems.

Text Books:

- Henry OTT, "Noise reduction Techniques in Electronics Circuit", Wiley International, Second ed., 2009.

Reference Book:

- Balguruswamy, "Reliability Engineering", TATA McGraw-hill Publication, Third ed. , 2005
- Walter C. Bosshart, "Printed Circuit Board", Tata McGraw-Hill publication, Third ed. ,2009.

Course Outcomes:

- Analyze the requirement of Instrument and systems.[PEO1][PO-e]
- Design various electronic circuits ,noises identification and appropriate elimination methods related to instrument and system[PEO2][PO-e]
- Select, design appropriate enclosure, cables, PCB. [PEO2] [PO-c]
- Estimate, analyze, improve the reliability of instrument and system [PEO2] [PO-K]

IE- 09013 Analytical Instrumentation

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks:Continuous evaluation-Assignments/Quiz-40 Marks,
End-Sem Exam- 60 Marks

Unit 1 **(5 hrs)**

Introduction to Chemical instrumental analysis, advantages over classical methods, classification: Spectral, electro analytical and separative methods, Interaction of radiation with matter, Laws of photometry (Beer and Lambert's law), Deviation from Beer's law, working of filters, prism and grating monochromators, concept of design of analytical instrument

Unit 2 **(10 hrs)**

Colorimeters, online colorimeter for process applications, turbidity meter, UV-Visible spectrophotometers and its types with its optical system design, IR spectrophotometers, X-ray spectroscopy

Unit 3 **(6 hrs)**

Emission Spectra, Quantitative measurements, Flame Photometer and its applications , concept of design atomic absorption spectrophotometer, spectrum interpretation, interferences, applications of atomic absorption spectrophotometer

Unit 4 **(8 hrs)**

Classification of Chromatographic methods, Gas chromatography, Process Gas Chromatograph, Liquid Chromatography, High Performance Liquid Chromatography (HPLC)

Unit 5 **(8 hrs)**

Different types of gas analyzers for measurement of Oxygen, NO_2,ammonia, carbon dioxide and hydrocarbons , Real world applications : Environmental monitoring system, real time gas leakage monitoring working principle and applications of laboratory instruments : centrifuge, oven, stirrers

Unit 6 **(5 hrs)**

Working principle, analyzers and detector types of mass spectrometer, applications

Text Books:

- Willard, Merritt, John AurieDean, "Instrumental Methods of Analysis", CBS Publishers & Distributors, New Delhi, Seventh ed., 1988.
- R. S. Khandpur, "Handbook of Analytical Instruments", Tata McGraw–Hill Publications, Second ed., 2006.

Reference Books:

- Bela G Liptak, "Analytical Instrumentation Handbook", Chilton, Second ed., 1994.
- Leslie S Ettre, Albert Zlatkis, "The Practice of Gas Chromatography", John Wiley and son's publication, First ed., 1967.
- Skoog, Holler, Nieman, "Principles of Instrumental Analysis", Thomson books-cole publications, Sixth ed., 2006.

Course Outcomes:

- Summarize and classify capabilities and limitations of analytical instruments. [PEO1][PO-e]
- Justify use of an analytical instrument in solving real world problem. [PEO3][PO-d]
- Familiarize with current literature, research in analytical instrumentation. [PEO2][PO-j]

IE - 09014 Process Loop Components Laboratory

Teaching Scheme

Practical: 3hrs/week

Examination Scheme

Term-work: 50 Marks

Practical Exam- 50 Marks

List of Experiments:

1. Design of signal conditioning for a K-type thermocouple/ RTD
2. Development of mathematical model of control valve
3. Configuration of D.P Transmitter and its application for flow
4. Calibration of I/P converter
5. Tuning of PID controller
6. Study of control valve & plot the characteristics of control valve
7. Implementation of Discrete control using PLC programming
8. Implementation of Timer for a given applications using PLC
9. Implementation of Counter for a given applications using PLC
10. Interfacing PLC to hydraulic circuits
11. Interfacing PLC to Pneumatic circuits
12. Designing intrinsic safety circuits (Zener barrier)

Course Outcomes:

- An ability to design transmitter.[PEO1][PO-b]
- An ability to test and select final control element.[PEO1][PO-l]
- Implementation of logic using programmable Logic Controller.[PEO1][PO-m]

IE - 09015 Digital Signal Processing Laboratory

Teaching Scheme

Practical: 3hrs/week

Examination Scheme

Term-work: 50 Marks

Practical Exam- 50 Marks

List of Experiments:

1. Discrete Fourier Transform

2. Fast Fourier transforms
3. Design and implement FIR filter using windowing method
4. Design and implement IIR filter using Butter worth approximation
5. Design and implement IIR filter using Chebeshev approximation
6. IIR filters design using least square method
7. Sine/square wave generation
8. FIR filters implementation
9. IIR filters implementation
10. FFT implementation
11. Effect of finite word length calculations
12. Practical Based real signal acquisition & analysis

Course Outcomes:

- Generate various signals from DSP kit and perform convolution of two signals.[PEO1,PO-a,e]
- Implement and determine DFT, FFT and IDFT of signals.[PEO1, PO-e]
- Determine the frequency responses of various signals. [PEO1, PO-a]
- Apply the knowledge of various techniques to design FIR and IIR filters using MATLAB. [PEO1,PO-e,k]

IE - 09016 Instrument and System Design Laboratory

Teaching Scheme

Practical: 2hrs/week

Examination Scheme

Term-work: 50 Marks

Practical Exam- 50 Marks

Contents:

Students are required to develop various modules required for their final year project, or a minim project e.g. power supply, processor module, interfacing module, display and signal conditioning module. The PCB and enclosure design is part of the activity of this subject. Testing of various modules as per industrial standards and practices is part of the experimental work. System Design Selection of sensors, signal conditioning, standard signals and noise considerations of typical systems

Course Outcomes:

- Design and implement the mini project which includes measurement of parameter signal processing, controlling, debugging related to objectives defined in the problem statement. [PEO1,PEO2,PEO3][PO-e, PO-,k, PO-d, PO-d, PO-l]

IE - 09017 Analytical Instrumentation Laboratory

Teaching Scheme

Practical: 2hrs/week

Examination Scheme

Term-work: 50 Marks

Practical Exam- 50 Marks

List of Experiments:

1. To find out transmittance and absorbance of a given sample using colorimeter
2. Qualitative and quantitative analysis using UV-Visible spectrophotometer
3. To analyze a given water sample using turbidity meter
4. To detect hydrocarbon contents from a gas sample
5. To design low cost analytical instrument

Course Outcomes:

- Develop analytical instrument with emphasize on safe use of analytical instruments. [PEO2] [PO-c]
- Critique spectroscopy and perform simple analytical procedures on a given sample using colorimeter and UV-Visible spectrophotometer. [PEO3] [PO-d]
- Identify, formulate and solve a real world problem based on chromatography analysis [PEO1] [PO-e]

ML - 09001 Constitution Of India

Teaching Scheme	**Examination Scheme**
Lectures : 2 hrs/week	20 marks: Continuous evaluation- Assignments /Quiz End - Sem Exam – 30 Marks

Unit 1 **(5 hrs)**

Preamble to the constitution of India. Fundamental rights under Part – III – details of Exercise of rights, Limitations & Important cases.

Unit 2 **(5 hrs)**

Relevance of Directive principles of State Policy under Part – IV. Fundamental duties & their significance.

Unit 3 **(4 hrs)**

Union Executive – President, Prime Minister, Parliament & the Supreme Court of India.

Unit 4 **(4 hrs)**

State executive – Governors, Chief Minister, State Legislator and High Courts.

Unit 5 **(4 hrs)**

Constitutional Provisions for Scheduled Castes & Tribes, Women & Children & Backward classes. Emergency Provisions.

(4 hrs)

Unit 6

Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments.

Text Books:

1. Durga Das Basu: "Introduction to the Constitution of India" (Students Edn.) Prentice – Hall EEE, 19th/20th Edn., 2001.
2. "Engineering Ethics" by Charles E.Haries, Michael. S.Pritchard and Michael J.Robins Thompson Asia, 2003-08-05.

Reference Books:

1. "An Introduction to Constitution of India" by M.V.Pylee, Vikas Publishing, 2002.

Course Outcomes:

At the end of this course students will be aware about the Constitution:

- Appreciate the complexity of implementation of any law.
- Appreciate the roles and functions of various high officials.
- Know about Fundamental rights of citizens of India.
- Understand the Electoral process.
- Understand the provisions made for special groups and categories in the constitution

Annexure I

List of Open Elective/Professional Science courses offered by ALL Departments

Sr. No	Department	Course
1	Civil	Finite Elements in Engineering
2	Mechanical	1. Unconventional Machining Processes 2. Modern Control Systems 3. Power Plant Engineering
3	Electrical	1. Industrial Drives 2. Control System Engineering
4	Electronics and Telecommunication	Electronic Communication Systems
5	Metallurgy and Material Science	Composite Materials
6	Instrumentation and Control	Industrial Automation
7	Production	1. Introduction to ERP 2. Operations Efficiency
8	Computer Engineering	Information Systems
9	Information Technology	Information Systems
10	Applied Science	1. Humanities Course 2. Constitution of India
11	Innovation Centre	Liberal Learning Course

Annexure II

List of Liberal Learning courses offered at Institute Level

- **Agricultural** – Animal Science, Forestry, Horticulture, Floriculture, Sustainable Agriculture, Veterinary
- **Arts** – Graphic Design, Interior Design, Fashion Design
- **Basic Sciences** – Astronomy, Astro- Physics, Biology, Genetics, Kinesiology, Microbiology, Neuro Sciences.
- **Business** – Administration, Communication, Entrepreneurial studies, Hostel Management, Marketing.
- **Defense Studies** - Military Studies, Naval Studies, Air Force Studies, War strategies.
- **Education** - Education policies, Engineering Education, Teacher Training.
- **Environmental Sciences** – Ecology, Meteorology
- **Linguistics** – Word Language
- **Medicine** – Health Studies Nutrition and dietetics
- **Performing Arts**- Music, Dance Theatre, Cinema
- **Philosophy**- Religious Studies
- **Sports and Athletics**