INSTRUMENTATION AND CONTROL ENGINEERING

M. Tech. (Process Instrumentation)
Effective from A. Y. 2014-15

INDEX

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

Program Education Objectives (PEOs):

PEO1: Practice the knowledge of Instrumentation and Control Engineering and allied and related fields.

PEO2: Demonstrate technical, communication skills and team sprit along with leadership qualities to pursue career in broad areas of instrumentation and Control Engineering.

PEO3: Engage in life-long learning through independent study and research.

PEO4: Undertake responsibilities for societal, environmental and ethical causes.

Program Outcomes (POs):

PO1: Acquire knowledge of Instrumentation and Control Engineering with ability to evaluate, analyze and synthesize knowledge related to Process Instrumentation.

PO2: Analyze complex problems related to Instrumentation and Control Engineering and synthesize the information for conducting research.

PO3: Think laterally to solve problems related to Instrumentation and Control Engineering and provide/suggest a range of solutions considering health, safety, societal, and environmental factors.

PO4: Extract knowledge through literature survey, experimentation and appropriate research methodology, techniques and tools.

PO5: Learn and use contemporary tools for solving problems related to Process Control, Automation, Measurement and Control etc.

PO6: Understand group dynamics and rational analysis in order to achieve common goals.

PO7: Ability to write clearly and to document own work for effective utilization.

PO8: Engage in life-long learning and learning through mistakes with / without external feedback.

PO9: Understand the impact of research and responsibility in order to contribute to the society.

PO10: Understand the role of a leader, leadership principles and attitude conducive to effective professional practice of Instrumentation and Control Engineering.

CURRICULUM STRUCTURE OF M Tech (Instrumentation and Control)
Specialization: Process Instrumentation
Effective from Academic year 2014-15

I-Semester

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	OEC-I/IS-501-9	Advanced Mathematics	3	--	--	3
2	Core-I/PI-511	Transducer Design	3	--	--	3
3	Core-II/PI-513	Instrument Design Engineering	3	--	--	3
4	Core-III/PI-515	Modern Control Theory	3	--	--	3
5	DE-I/PI-531	A. Process System Engineering	3	--	--	3
	DE-I/PI-533	B. Industrial Automation				
6	CS/PI-519	Course Seminar	--	--	2	1
7	LLC/LL-503	Liberal Learning Course	1	--	--	1
8	PGL/PI-521	PG Laboratory –I	--	--	6	3
		Total	**16**	**0**	**8**	**20**

II-Semester

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	OEC-II	Open Elective / Science Elective	3	--	--	3
2	DE-II/ PI-514	A. Advanced Control System	3	--	--	3
	DE-II/ PI-528	B. Robotics				
	DE-II/ PI-530	C. Fiber Optics and LASER technology				
	DE-II/ PI-518	D. Soft Computing				
3	Core –IV/PI-502	Embedded Systems	3	--	--	3
4	PSC-I/PI-516	A. Advanced Process Instrumentation	3	--	--	3
	PSC-I/PI-526	B. Process Dynamics and Identification				
	PSC-I/PI-520	C. Building Automation				
5	PSC-II/PI-512	A. Batch Process	3	--	--	3
	PSC-II/PI-522	B. Advanced Digital Signal Processing				
	PSC-II/PI-524	C. Instrumentation for Strategic Application				
6	MLC/ML-504	Intellectual Property Rights	1	--	--	1
7	PGL/PI-510	PG Laboratory -II	--	--	6	4
		Total	**16**	**0**	**6**	**20**

III-Semester

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	MLC/ML-603	Environmental Studies	2	--	--	2
2	MLC/ML-601	Constitution of India	2	--	--	2
3	PS-I/PI-601	Project Work	--	--	--	16
		Total	**4**	**0**	**0**	**20**

OR

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	OEC/ BSC	Humanities and Social Science Courses	3	--	--	3
2	LLC	Liberal Learning Course	1	--	--	1
3	PS-I/PI-601	Project (Dissertation) Stage I	--	--	--	16
		Total	**4**	**0**	**0**	**20**

IV-Semester

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	PS-II/PI-602	Project Work	--	--	--	20
		Total	**0**	**0**	**0**	**20**

IS-501-9 Advanced Mathematics

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Content

Introduction, Statement of optimization problem, Engineering Applications, classification of optimization, Single variable and Multivariable of Optimization with no constraints, Multivariable of Optimization with Equality constraints, Multivariable of Optimization with Inequality constraints. Introduction and formulation of the problem. Graphical method, simplex method, duality concept in LPP and solution of the dual. Theory of reliability, maintainability, availability, failure distribution, MTTF, MTBF, Hazard rate, Bath tub curve, state dependent systems, series and parallel connections, redundancy of systems. Introduction, control charts of all types, ISO 9000 series and their importance, OC curves advantages and limitations of SQL in industries. Numerical solutions to the ordinary differential equations of first and second order with initial and boundary conditions, Picard's Method, Taylor's Method, Euler's Method, modified Euler's Method, Milne's Method and Runge -Kutta Method. Finite difference equivalence to partial derivatives, elliptical, parabolic and hyperbolic equations, applications to one dimensional and two dimensional equations, Schmidt and Crank-Nicholson's Method.

Text books:

- Engineering Mathematics, Erwin Kreyszig, 9th Students edition, Wiley International
- Reliability and Maintainability Engineering, Charles Ebeling, Tata McGraw Hills Publication
- Engineering Optimization, S. S. Rao, New Age Publication

Reference books:

- Numerical Mehods – S. S. Sastry
- Statistical methods- S. P. Gupta
- Higher Engineering Mathematics – B.V.Ramana
- Operations Research- S. D. Sharma
- Theory and Problems in Numerical Methods – T. Veerarajan, T.Ramachandran
- Probability and Statistics in Engineering – W. W. Hines et al

Outcomes:

- Knowledge of optimization techniques and importance of reliability theory, numerical methods used in research [PEO1][PO-1]
- Ability to understand the use of statistical quality control in engineering research.[PEO1][PO-2]

PI-511 Transducer Design

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Contents:

Review of transducers for various parameters like temperature, pressure, flow, level, humidity, acceleration, vibration, density etc. Design considerations and selection criterion as per standards, Sensor fabrication techniques, process details, and latest trends in sensor fabrication, fiber optics sensors, electromechanical sensors, Solid state chemical sensors, Bio-sensors, Piezo-resistive sensors, characterization of sensors, effect of sensors on process identification, signal conditioning techniques.

Reference Books:

- Chapman, P., "Smart Sensors", ISA Publications,1995.
- ISA–S37.1–1975 (Reaffirmed 1982), "Electrical Transducer Nomenclature and Terminology," Instrument Society of America, 1975.
- Sabrie Soloman, "Sensors Handbook", McGraw-Hill , 1999
- Brayan Eggins, "Chemical Sensors and Biosensors" John Wiley& Sons, 2003.
- Eric Udd , "Fiber optics sensors",Wliey,1991

Outcomes:

- Knowledge of mathematical equations for the sensor design. [PEO1] [PO-1]
- Implementation of various sensors required for process plants. [PEO2] [PO-4]

PI-513 Instrument Design Engineering

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Contents:

Electromagnetic Compatibility: Noise, Interference, Noise Coupling, cabling, grounding, ground loops, balancing and filtering
Shielding: Near field, far field, absorption losses, and reflection losses
Contact Protections: Arc discharge, Glow discharge, intrinsic noise sources, active device noise, digital circuit grounding
EMC Applications: Digital circuit power distribution, Digital circuit radiations, Conducted emissions, RF and transient immunity, electrostatic discharge, PCB layout and design, EMC measurements. Automated Test equipment

Reference Books

- Henry W Ott, " Electromagnetic Compatibility Engineering", Jonh Wiley and Sons Inc. Publication, 2009
- W. C. Bossshart , "PCB Design and Technology" Tata McGraw Hill, 1987
- Clyde F. Coombs, "Electronic Instrument Handbook", McGraw Hill, Third Edition, 2005

Outcomes:

- An ability to analyze and justify the requirement of Instrument and systems. [PEO1]PO1]
- An ability to design various electronic circuits and measurement systems, noises identification and appropriate elimination methods related to instrument and system[PEO1][PO2]
- An ability to select, design appropriate enclosure, cables, PCB.[PEO1][PO5].
- An ability to estimate, analyze, improve the reliability of instrument and system[PEO3][PO2]

PI-515 Modern Control Theory

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Contents:

State space analysis, eigen values and eigen vectors, feedback control system using state space, Controller and observer design, Design using Ackermann formula, Frequency domain controller, Introduction to discrete time control, Controller design in discrete domain

Reference Books:

- H. Nijmeijer and AVD Schaft, "Nonlinear Dynamical Control Systems", Springer Verlag, New York, 1990.
- JJE Slotine and W. Li, "Applied Nonlinear Control", Prentice Hall, New Jersey, 1991.
- B. Friedland, "Advanced Control System Design", Prentice Hall, New Jersey, 1996.
- HK Khalil, "Nonlinear Systems", Prentice Hall, New Jersey, 2002.

Outcomes:

- An ability to design continuous state feedback controller and observer in state space. [PEO1] [PO-l]
- An ability to design discrete state feedback controller and observer for continuous system. [PEO1] [PO-l]
- Ability to design compensators in continuous and discrete domain [PEO1][PO-l]

PI-531 Process System Engineering

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

Course Contents:

Introduction to Unit operations, understanding and development of systematic procedures for the design and operation of process system, separation processes, computer based techniques for design, operation and management of process plants, case study of chemical process plants.

Reference Books:

- Warren McCabe , Julian Smith, Peter Harriott, "Unit operations of Chemical Engineering", Mc Hills , 7th Edition 2004.
- Lorenz T. Biegler, Egnacio e. Grossmann and Arthur W Westerberg, "Systematic Methods for chemical process design", Prentice Hall, 1997.
- D Warren D. Seider, J. D. Seader, Daniel R Lewin, Soemantri Widagdo, "Product and process design principles: Synthesis, Analysis and design", Wiley, 3rd Edition 2008.
- Subhash K Sikdar,Mahmoud M. El-Halwagi, "Process design tools for the Environment", CRC Press, 2001.

Outcomes:

- Demonstrate various unit operations in process plants. [PEO2] [PO-4]
- Implementation of control schemes on existing platforms. [PEO1] [PO-2]

PI-533 Industrial Automation

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

Course Contents:

Evolution of instrumentation and control, Role of automation in industries, Benefits of automation. Different types of processes. Typical examples of continuous, batch, discrete and hybrid processes. Study of Process flow , detailed P&ID, Critical loops, Safety and Alarms, Reliability and Fail safe operation requirements, Efficient running and adhering to standards.
Different standard for programming the control system Different types of control system. Controlling advance applications with DCS, SCADA and PLCs. Discussion of available and suitable feature in hybrid control system.
HART, Foundation fieldbus, Profibus protocol introduction, frame structure, programming, implementation examples, Benefits, Advantages and Limitations
Comparison with other fieldbus standards including Device net, Profibus, Controlnet, CAN, Industrial Ethernet etc
Distributed Control Systems Engineering and Design
DCS detail engineering, specifications, configuration and programming, functions including database management, reporting, Sequential event recording alarm management, communication, third party interface, control, display etc. Enhanced functions viz. Advance Process Control, Batch application, Historical Data Management, OPC support, Security and Access Control etc. Performance Criteria for DCS and other automation tools.

Reference Books:

- Popovic and Bhatkar , " Distributed Computer Control For Industrial Automation" , Marcel Dekker,INC, 2005.
- Webb and Reis, "Programmable Logic Controllers: Principles and Applications", PHI, 2009.
- S.K.Singh, "Computer Aided Process Control", PHI, 2007.

Outcomes:

- Selection of DCS & network protocol based on applications.[PEO1][PO-3]
- Implementation of DCS for various process/plant.[PEO2][PO-5]

PI-519 Course Seminar

Course Contents:

The students are required to search / gather the material / information on a specific a topic comprehend it and present / discuss in the class.

Outcomes:

- Ability to understand of contemporary / emerging technology for various processes and systems. [PEO1][PO-4]
- An ability to share knowledge effectively in oral and written form and formulate documents [PEO2] [PO-6]

PI-521 PG Laboratory I

The students are expected to do the following:

- To get familiarize about the facilities available in the laboratory.
- To design, implement and verify the results of various experiments as per the suggestions of laboratory instructor.
- To devise, suggest and implement innovative experiments in the laboratory.
- To collaborate with other labs for implementing small projects.
- To suggest and provide solutions for upgrading the laboratory facilities.

Outcomes:

- Understanding the basics of state-of art software and hardware tools and its usability [PEO1][PO5]
- Capable of developing small projects proving the basic concepts [PEO3][PO3]
- Able to teach, develop experiments and share his knowledge and competency with others [PEO2][PO7]
- Capable of pursuing research in domain of Instrumentation and Control Engineering [PEO3][PO8]

PI-502 Embedded Systems

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

Course Contents:

Introduction to Reconfigurable Computing, FPGA Architectures
FPGA Design Cycle, Technology-independent optimization, Technology Mapping, Placement and Routing, FPGA Vs ASIC design, Algorithm Prototyping and benchmarking, area, speed and power analysis for FPGA design, Floating Point Design (Implementing math functions), Reconfigurable Computing Applications –Bioinformatics, Process Automation, Image processing, Computational Fluid Dynamics, Power Electronics;
FPGAs vs. Multicore architectures
Advanced FPGA Design, Dynamic Reconfiguration, Partial Reconfiguration;

Text Books:

- Steve kilts , "Advanced FPGA Design- Architecture, Implementation and Optimization", John Willey and Sons, 2007

Reference Books:

- Scott hauck and Andre Dehon "Reconfigurable computing: Theory and Practice of FPGA based computing", Elsevier, 2008
- Dennis Silage, "Embedded Desing Using Programmable Gate Arrays", Bookstand Publishing, 2009
- Maya V. Gokhale and Paul S. Grahmn , "Reconfigurable Computing: Accelerating Computations with FPGA", Springer, 2005

Outcomes:

- Understanding of the basic principles of Microcontroller based design and development. [PEO1][PO-1]
- Ability to design and build a functional prototype for real world applications.
- [PEO2][PO-3]
- To encourage the students to have a better understanding on state-of-art embedded technologies like system-on-chip design and reconfigurable embedded designs, their potential applications and their market views. [PEO2][PO-2]
- Ability to work in a group to design systems, solve problems and its applicability for the society. [PEO2][PO-6]
- To test whether students can apply their knowledge of fundamentals of Microcontrollers, programming and interfacing technology to solve and design simple engineering problems. [PEO3][PO-5]

PI-514 Advance Control System

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

Course Contents:

Introduction to uncertain systems. Nonlinear systems. Feedback linearization. Lyapunov stability theory. Design of controllers for nonlinear systems. Sliding mode control, chatter control, invariance and matching conditions, reaching phase elimination. Backstepping technique. Model following. Discrete sliding mode control. Unified sliding mode theory. Methods of uncertainty estimation. Adaptive sliding mode control, time delay control, inertial delay control, disturbance observers. State observers. Simultaneous state and uncertainty observers.
Some case studies.

Reference Books:

- C. Edwards and S.K. Spurgeon, "Sliding Mode Control: Theory and Applications", Taylor & Francis, 1998.
- G. Bartolini, L.Fridman, A. Pisano and E. Usai (Ed.), "Modern sliding mode control theory", Springer, 2008.
- J.J.E Slotine and W. Li, "Applied nonlinear control", Prentice Hall, 1991.

Outcomes:

- An ability to design continuous sliding mode controller and observer. [PEO1] [PO-l]
- An ability to design discrete using delta operator controller and observer for linear and nonlinear systems. [PEO1] [PO-l]
- Ability to design controller for uncertain and disturbed systems. [PEO1] [PO-l]

PI-528 Robotics

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Contents:

Introduction:- Basic Concepts such as Definition , three laws, DOF…..etc. , Robotics and automation, Robot anatomy, Classification, structure of robots, point to point and continuous path robotic systems. Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc..
Robot Grippers:- Types of Grippers , Design aspect for gripper, Force analysis for various basic gripper system
Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot

Drives:- Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems
Control Systems :- Types of Controllers, Introduction to closed loop control, second order linear systems and their control, control law partitioning, trajectory-following control, modelling and control of a single joint, Present industrial robot control systems and introduction to force control
Kinematics :- Transformation matrices and their arithmetic, link and joint description, Denavit - Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods
Velocities and Static forces in manipulators: Motion of the manipulator links, Jacobians, singularities, static forces, Jacobian in force domain
Dynamics: - Introduction to Dynamics , Trajectory generations , Manipulator Mechanism Design
Machine Vision System: - Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation
Robot Programming : Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages : Introduction to various types such as RAIL and VAL II …etc, Features of each type and development of languages for recent robot systems
Artificial Intelligence: - Introduction to Artificial Intelligence, AI techniques, Need and application of AI
Associated Topics in Robotics:- Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics, International Scenario for implementing robots in Industrial and other sectors. Future scope for robotisation

Text Books:

- John J. Craig, " Introduction to Robotics (Mechanics and Control)", Addison-Wesley, 2nd Edition, 2004
- K.S. Fu, R.C. Gonzales, C.S.G. Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987.
- Mikell P. Groover et. al., "Industrial Robotics: Technology, Programming and Applications", McGraw – Hill International, 1986.
- Shimon Y. Nof, "Handbook of Industrial Robotics ", John Wiley Co, 2001.

Reference Books:

- Richard D. Klafter, Thomas A. Chemielewski, Michael Negin, "Robotic Engineering: An Integrated Approach", Prentice Hall India, 2002.

Outcomes:

- Ability to determine the various kinetics and dynamics of a robotic arm.[PEO-1][PO-1]
- Ability to understand and implement the different control techniques for manipulators.[PEO2][PO-2]

PI-528 Fiber Optics and LASER technology

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Contents:

Optical fiber: Light, waveguide, total internal reflection, NA, acceptance, critical angle
Optical fiber characteristics: attenuation, dispersion, refractive index profile, bending losses, polarization, optical amplifiers
Optical fiber sensors: different parameters such as light intensity, phase, etc to measure temperature, level, pressure, vibration
Optical sources: LED and LASERs, principle of LASERs, types of LASERs
LASERs application in biomedical: Endoscope, ophthalmic surgery, other surgical applications
LASER Applications: Holography, measurement of stain, stress, vibration, LASER gyroscope

Reference Books:

- J Wilson, "Optoelectronics", Prentice Hall India
- Silvano Donati, "Electro Optical Instrumentation", Pearson Education
- Jonh Dakin and Brian Culshaw , "Optical Fiber Sensors"
- Joseph T Verdeyen , "LASER Electronics", PHI, Second Edition

Outcomes:

- Ability to apply optical fiber for sensing various physical parameter[PEO1][PO-1]
- Analyzed the advantages of optical fiber sensor over conventional sensors [PEO2][PO-3]
- Application of LASER in various deceases[PEO2][PO-4]

PI-518 Soft Computing

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Contents:

Knowledge based methods
Expert systems (ES)
Fuzzy expert system (FES)
Analytical Hierarchical methods (AHP)
Data mining methods: Neural Networks (NN), Genetic Algorithms (GA), Support Vector machine (SVM)

Reference Books:

- S N Shivanandam, "Introduction to Neural Networks Using MATLAB 6.0", TMH
- Timothy Ross , "Fuzzy logic with application to engineering systems", McGraw Hill
- Klir G and T. Folger, "Fuzzy sets, uncertainty, and information", Prentice Hall

Outcomes:

- Understand and evaluate different soft computing techniques. [PEO1] [PO-1]
- Identification and implementation of the data mining techniques to solve complex problems. [PEO2] [PO-5]

PI-516 Advance Process Instrumentation

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Contents:

Process identification using various techniques, Analysis of some common processes like Distillation column, Boilers, Heat Exchangers, Dryers, Continuous Stirred Tank Reactor, Compressors. Modeling of some common processes & Utilities like Boiler, Refrigeration unit, Chiller plant, D. M. water plant, Instrument air supply. Application of Advanced process Instrumentation Tools to various processes.

Reference Books:

- Andrews and Williams, "Principles of Applied instrumentation", Vol. I, II, III, IV, Gulf Publications company
- F. G. Shinsky, "Process Control System," Mc Graw Hills, 1996.
- B.G. Liptak , "Process Control", Chilton Publications, Fourth edition, 2009.
- Design and Application of Process Control Systems, ISA

Outcomes:

- Utilization of various process identification techniques. [PEO1] [PO-1]
- Implementation of control schemes for different processes [PEO2] [PO-2]

PI-526 Process Dynamics and Identification

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Contents:

Introduction to process dynamics, development of dynamic models for typical unit operations from 1st principle , techniques for model identification using empirical information, introduction to process optimization, methods for parameter estimations and validation, process performance analysis and advanced process control.

Reference Books:

- Dale E. Seborg, Duncan A. Mellichamp, Thomas F Edgar and Francis J. Doyle III, "Process dynamics and control", Wiley, 3rd edition 2010.
- B. Wayne Bequette, "Process Dynamics: modeling analysis and simulation", Prentice Hall, 1st Edition, 1998.
- Thomas F Edgar, "Optimization of Chemical processes", McGraw Hill, 2nd Edition , 2001.
- Lennart Ljung, "System Identification: Theory for the User", Prentice Hall, 2nd Edition, 1999.
- R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, "Transport Phenomena", John Wiley & Sons, 2nd Edition 2006.
- H. Scott Fogler, " Elements of Chemical Reaction Engineering", Prentice Hall, 4th Edition, 2005.
- Jeffrey B. Burl, "Linear Optimal Control", Prentice Hall, 1998.

Outcomes:

- Correlation of the process dynamics and plant performance.[PEO1] [PO-1]
- Implementation of optimization tools for different processes. [PEO2] [PO-2]

PI-524 Instrumentation for Strategic Application

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

Course Contents:

Introduction to process control, control objective and benefits, process dynamics, analysis for process control, dynamic behavior of typical process systems, PID algorithms, stability analysis and controller tuning, process control design: definition and design, managing the design procedure, continuous improvement.

Reference Books:

- Thomas E. Marlin, "Process control designing processes and control system for dynamic performance", McGraw Hill,
- Armando B. Corripio, "Design and Application of Process Control Systems", ISA
- P.W.Murrill, "Fundamentals of process control theory", ISA, 3rd edition

- William L. Luyben, "Process modeling, Simulation and Control for Chemical engineers", McGraw Hill

PI-520 Building Automation

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

Course Contents:

Introduction, concept and application of Building Management System and Automation. Features, Characteristics, Drawbacks of Building Automation system. Various Systems of Building Automation – Building Management System, Energy Management System, Security System, Safety System, Video Management System, PA and EPBX systems. Requirements and design considerations and its effect on functional efficiency of building automation. Common building control network implementations and protocol standards including Web based applications, BACnet, Ethernet, Arcnet, LonTalk and various proprietary systems. Integration of Building Management System, Energy Management System, Safety System, Security Systems & Video Management, Benefits of Integrated Systems, Challenges, Future Prospects of Integrated Systems. Brief cycle of project cycle and management.

Reference Books:

- Reinhold A. Carlson Robert A. Di Giandomenico, "Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, Building", 1st edition (R.S. Means Company Ltd), 1991.
- Shengwei Wang "Intelligent Buildings and Building Automation" , Spon press, 1st edition 2010.
- Albert Ting-pat So, Wai Lok Chan, "Intelligent Buildings systems", Kluwer Academic publishers.

Outcomes:

- Designing different systems for building automation and integrate those systems. [PEO2][PO-2]
- Identification of implementation issues associated with BMS [PEO1][PO-3]

PI-522 Advanced Digital Signal Processing

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

Course Contents:

Advanced digital signal processing methods to include: statistical and deterministic least squares filter design, finite length register effects and their optimization in digital filters, Multirate Signal Processing, Wavelet Transform, Hadamard Transform, DCT, Nonlinear filters, Adaptive Filters, Advanced DSP Processors and associated tools, Case studies and applications

Reference Books:

- Proakis, Manolakis, "DSP Principles, algorithms and applications", PHI
- A Antoniou , "DSP filter analysis & Design" , McGraw Hill, 1979
- Avtar singh, S. srinivasan , "DSP Implementation using DSP microprocssors with examples from TMS320C54XX" TMH
- Lapsley p. Bier J, Shoham A, Lee E. "ADSP processor fundamental architecture and features", Piscataway, N.J.IEEE, 1997

Outcomes:

- Acquire knowledge of advances in digital signal processing and its applications to Instrumentation and Control Engineering with ability to evaluate, analyse and synthesize knowledge related to Process Instrumentation, Instrumentation & Control Engineering, etc.[PEO1] [PO-1]
- Think laterally to solve problems related to Instrumentation and Control Engineering and provide / suggest a range of solution through literature survey, experimentation and appropriate research methodology, techniques and tools. [PEO2][PEO3] [PO-3] [PO-4]

PI-512 Batch Process

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

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

Course Contents:

Introduction to Batch Control System, Batch Control system terminology, Characteristics of Batch Processes, Hierarchical Batch Model, Control structure for batch systems.
International Standards and Practices such as S 88, S 95, USA FDA regulation, 21CFR 11, etc. regulatory and discrete systems, Batch control design, system hardware and software, Batch control system specifications and implementation, Information/display requirements, cost justification and benefits, data management.
Case study of batch control system implementation for applications in food and beverages, pharmaceuticals, etc.

Reference Books:

- T. G. Fisher, "Batch Control System", ISA series, 2nd Edition, 2010.
- Gregory K. Macmillan, Process/ Industrial Instruments and Controls Handbook, MCGrawHill

Outcomes:

- Acquired knowledge of standards used for Batch process control [PEO-1][PO-3]
- Development of control schemes for different batch processes [PEO-2][PO-2]

PI-510 PG Laboratory II

Teaching Scheme	**Examination Scheme**
--	100 marks: Continuous evaluatio- 50 Marks, End- Sem Exam- 50 Marks

Course Contents:

The students are expected to do the following:

- To get familiarize about the facilities available in the laboratory.
- To design, implement and verify the results of various experiments as per the suggestions of laboratory instructor.
- To devise, suggest and implement innovative experiments in the laboratory.
- To collaborate with other labs for implementing small projects.
- To suggest and provide solutions for upgrading the laboratory facilities.

Outcomes:

- Understanding the basics of state-of art software and hardware tools and its usability [PEO1][PO-5]
- Capable of developing small projects proving the basic concepts [PEO3][PO-3]
- Able to teach, develop experiments and share his knowledge and competency with others [PEO2][PO-7]
- Capable of pursuing research in domain of Instrumentation and Control Engineering [PEO3][PO-8]

PI-601 Dissertation Stage I

Teaching Scheme	**Examination Scheme**
--	100 marks: Continuous evaluatio- 50 Marks, End- Sem Exam- 50 Marks

Course Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.

The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey
- Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

Outcomes:

- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem [PEO1][PO-l]
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design [PEO3][PO-4]
- Ability to present the findings of their technical solution in a written report[PEO2][PO-7]

PI-602 Dissertation Stage II

Teaching Scheme	Examination Scheme
--	100 marks: Continuous evaluatio- 50 Marks, End- Sem Exam- 50 Marks

Course Contents:

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them.

It may be based on:

- Entirely on study and analysis of typical Instrumentation and Control system, Process Instrumentation / devices / instruments / related topic
- Experimental verification / Proof of concept
- Design, fabrication, testing, and calibration of an instrumentation system

- The viva-voce examination will be based on the above report and work

Outcomes:

- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem [PEO1][PO-l]
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design [PEO3][PO-4]
- Ability to present the findings of their technical solution in a written report[PEO2][PO-7]