NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Third Year Instrumentation Engineering

Faculty of Engineering and Technology

COURSE OUTLINE

SEMESTER – V and VI

W.E.F 2014 – 2015

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The Board of Studies in Instrumentation Engineering of North Maharashtra University, Jalgaon (India) has defined set of program education objectives. The Program Educational Objectives of Instrumentation Engineering are designed to provide graduates with:

PEO1: Professional Knowledge: Graduates shall acquire the fundamental and advanced knowledge in Instrumentation Engineering subjects along with additional knowledge on other subjects such as Mathematics, Inter-disciplinary Engineering, Management and Economics to solve basic and complex engineering problems. Graduates will be able to design system within realistic constraints for sustainable developments.

PEO2: Professional Employability: Graduates will have a successful career in Instrumentation Engineering. Graduates will succeed in getting the entry-level engineering positions as trainee engineer, project engineer, erection and commissioning engineer, automation engineer in process industries, Government Organizations at regional and national levels and as an Entrepreneur.

PEO3: Higher Studies & Life Long Learning: Graduates may pursue their professional development through self-learning, advanced degree and continue life-long learning. Graduates will be able to use software and modern engineering tools.

PEO4: Social Engineering: Graduates will aware of social responsibility, ethical values, safety standard, economical and environmental issues so that they serve the society better.

PROGRAM OUTCOMES (PO)

a. An ability to apply knowledge of mathematics, science, and engineering.

b. An ability to design and conduct experiments, as well as to analyze and interpret data.

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d. An ability to function on multidisciplinary areas and teams.

e. An ability to identify, formulates, and solve engineering problems.

f. An understanding of professional and ethical responsibility.

g. An ability to communicate effectively.

h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

i. Recognition of the need for, and an ability to engage in life-long learning.

j. Knowledge of contemporary issues.

k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practices in process industries.

l. An ability to work professionally in both software and hardware system areas including the design and realization of such systems.

North Maharashtra University, Jalgaon.

Syllabus Structure For Third Year Instrumentation Engineering w.e.f year 2014-15

Semester –V

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme				Total	Credits
							Theory		Practical			
			Theory Hrs /week	Tutorial Hrs /week	Practical Hrs /week	Total	ISE	ESE	ICA	ESE		
	Control System Components (TH)	D	3	--	--	3	20	80	--	--	100	3
	Digital Signal Processing (TH)	D	3	--	--	3	20	80	--	--	100	3
	Microcontroller & Application (TH)	D	3	--	--	3	20	80	--	--	100	3
	Power Electronics (TH)	D	3	--	--	3	20	80	--	--	100	3
	Industrial Management & Economics (TH)	C	3	--	--	3	20	80	--	--	100	3
	Control System Components (LAB)	D	--	--	2	2	--	--	25	--	25	1
	Digital Signal Processing (LAB)	D	--	--	2	2	--	--	25	25 (PR)	50	1
	Microcontroller & Application (LAB)	D	--	--	2	2	--	--	25	25 (PR)	50	1
	Power Electronics (LAB)	D	--	--	2	2	--	--	25	25 (PR)	50	1
	Electronic Workshop(LAB)	B	1	--	2	3	--	--	50	--	50	2
	Industrial Training /EDP/Special Study	D	--	--	--	-	--	--	25	--	25	2
	Total		**16**	**--**	**10**	**26**	**100**	**400**	**175**	**75**	**750**	**23**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA : Internal Continuous Assessment

North Maharashtra University, Jalgaon.

Syllabus Structure For Third Year Instrumentation Engineering w.e.f year 2014-15

Semester –VI

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme				Total	Credits
							Theory		Practical			
			Theory Hrs /week	Tutorial Hrs /week	Practical Hrs /week	Total	ISE	ESE	ICA	ESE		
	Digital Control System (TH)	D	3	--	--	3	20	80	--	--	100	3
	Data Communication & Telemetry (TH)	D	3	--	--	3	20	80	--	--	100	3
	Process Instrumentation (TH)	D	3	--	--	3	20	80	--	--	100	3
	Analytical Instrumentation (TH)	D	3	--	--	3	20	80	--	--	100	3
	Project Planning & Estimation (TH)	C	3	--	--	3	20	80	--	--	100	3
	Digital Control System (LAB)	D	--	--	2	2	--	--	25	25 (PR)	50	1
	Process Instrumentation (LAB)	D	--	--	2	2	--	--	25	25 (OR)	50	1
	Analytical Instrumentation (LAB)	D	--	--	2	2	--	--	25	--	25	1
	Virtual Instrumentation (LAB)	B	--	--	2	2	--	--	25	25 (PR)	50	1
	Minor Project	D	--	--	2	2	--	--	50	--	50	2
	Seminar-I	D	--	--	2	2	--	--	25	--	25	2
	Total		**15**	**--**	**12**	**27**	**100**	**400**	**175**	**75**	**750**	**23**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA : Internal Continuous Assessment

Course Title	Short Title	Course Code
Control System Components	**CSC**	

Course Description:

This course provides knowledge about various control system components. This course provides the knowledge of transmission and controlling of the various parameters and the knowledge of various control components used for automation in industries.

Lectures	**Hours / Week**	**No. o f Weeks**	**Total Hours**	**Semester Credits**
	03	15	42	03

Prerequisite Course(s): Knowledge of FE level & SE level.

General Objective:

The objective of the course is to provide students with a firm grasp of the essential principles of control system components.

Course Outcomes:

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

1. Apply the knowledge of the control system components for controlling various Industrial parameters.
2. Able to identify, formulate and solve a problem using hydraulic, electrical & pneumatic system.
3. Analyse the process characteristics and apply suitable controller to that process.
4. Correctly select type and size of control valves for industrial use.
5. Develop the ladder diagram with combinations of electronic, pneumatic and hydraulic components for reliable automation task.
6. Discharge professional duties in the field of automation.
7. Do higher studies in field of control system components for technical advancement in the field of automation and economic developments.

Control System Components
(Course Contents)

Semester-V **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit- I: Introduction to control system components **9 Hours, 16 Marks**

a. Comparison of different systems: hydraulic, pneumatic and electronic systems.
b. 2-wire transmitters, buoyancy, differential pressure transmitters.
c. Temperature, electro-hydraulic transmitters.
d. Resistance-to-current converter, voltage-to-current converter.
e. Pneumatic to electric converter, electrical to pneumatic converter.
f. Square root extractor, integrator and totalizer.

Unit- II: Control Valves **9 Hours, 16 Marks**

a. Terminology, types and characteristics, Selection of control valves.
b. Concept of Cv, calculation of Cv and trim size.
c. Cavitation and flashing, Noise in control valves, testing of control valve.
d. Valve positioners: necessity, types and effect on performance of control valves.
e. Electrical, Pneumatic and Hydraulic Actuators, Electro-pneumatic and Electro-Hydraulic Actuators.

Unit- III: PID Controllers and PLC **8 Hours, 16 Marks**

a. Pneumatic, hydraulic and Electronic PID controllers and their tuning.
b. Relay ladder diagrams, introduction to programmable logic controllers (PLC).
c. Architecture and specifications of PLC.
d. Ladder Programming, Development of ladder diagrams for various applications.
e. Advance PLC programming.

Unit- IV: Pneumatic and hydraulic components **8 Hours, 16 Marks**

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

Unit- V: Auxiliary components **8 Hours, 16 Marks**

a. Synchros, Servo motor, Stepper motor, Feeders and Dampers.
b. Intrinsic safety and components.
c. Gyroscope
d. Indicators and Alarm Annunicator.
e. Control Panel and their design.

References:

1. C.D.Jhonson , 'Process control and Instrument Technology' , Prentice-Hall of India.
2. D.Patranabis, 'Principles of process control', Tata McGraw-Hill.
3. N.A.Anderson, 'Instrumentation for process measurement and control', CRC Press.
4. Pipepinger, 'Industrial Hydraulics'.
5. Mujumdar, 'Pneumatic components and circuits', Tata McGraw-Hill.
6. I.J.Nagrath, M.Gopal., 'Control system Engineering', PHI..
7. JhonWebb, 'Programmable logic controllers', PHI.
8. Francis Raven, 'Automatic Control Engineering', McGraw-Hill.
9. Bela Liptak , 'Handbook of Instrumentation Engineers (process control)'.
10. Andrew Willams, 'Applied Instrumentation in process control (vol-1)', Gulf Publications.

Course Title	Short Title	Course Code
Digital Signal Processing	**DSP**	

Course Description:

This course provides knowledge about signal processing and its applications and gives the opportunity to design and implement the applications of DSP processor for biomedical, speech, image processing.

Lectures	Hours / Week	No. of Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s): Knowledge of programming language c and basic Digital electronics.

Course Objectives:

1. Understanding the basic principles of signal processing.
2. To Discrete time Fourier series & its properties, DFT, STFT, DWT.
3. To study and Design of FIR filter, and IIR Filter.
4. To study DSP hardware and Design Applications of DSP processor for biomedical, speech, image processing.

Course outcomes:

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

1. Ability to apply the various programming techniques on DSPs
2. Ability to design FIR and IIR filters using different techniques.
3. Ability to determine the frequency, steady state and transient response of LTI systems.
4. Ability to apply the DFT and FFT methods for various signals and determine their frequency response.

Digital Signal Processing
(Course Contents)

Semester-V **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures: 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit I: **09 Hours, 16 Marks**

a. Fourier series and Fourier transform & its properties.
b. Discrete time Fourier series & its properties.
c. Circular convolution, frequency response analysis of signal using DFT.
d. Linear filtering based on DFT FFT algorithms.
e. Use of FFT for spectral estimation, filtering & correlation.

Unit II: **09 Hours, 16 Marks**

a. Short Time Fourier Transform (STFT).
b. Introduction to multi-resolution transform.
c. Continuous wavelet transforms.
d. Discrete Wavelet Transform (DWT).
e. Simple application of DWT for noise filtering in one dimensional signal.

Unit III: **08 Hours, 16 Marks**

a. Introduction to Finite Impulse Response Filter, FIR filter design using different windowing techniques & frequency sampling method.
b. Design of linear phase FIR filter.
c. Introduction to computer-aided design of linear phase FIR filter.
d. Basic structure of FIR system.

Unit IV: **08 Hours, 16 Marks**

a. Introduction to Infinite Impulse Response Filter,
b. impulse invariance and bilinear transformation,
c. Design Specification of IIR Low pass filter and frequency transformation, Design of IIR filter using Butterworth, Chebyshev approximation.
d. Introduction to computer-aided design of IIR filter. Realization methods for IIR filter.

Unit V: **08 Hours, 16 Marks**

a. Introduction to multirate DSP, Introduction to DSP hardware.
b. TMS320C67XX processor, applications of TMS320C67XX e.g. square wave generator, matrix multiplication.
c. Applications of DSP processor for biomedical, speech, image processing.

References:

1. Proakis, Manolakis "Digital Signal Processing: Principles, algorithms and applications", PHI.
2. Oppenheium, Schaffer ,"Digital Signal Processing", PHI.
3. A. Nagoor Kani , "Digital Signal Processing", Mc. Graw Hill.
4. Rulph Chassaing ,"Digital Signal Processing, applications using C & TMS320CSX DSK", WILLEY publication.
5. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Microcontroller & Application	**M & A**	

Course Description:

This course provides knowledge about Microcontroller and their application and gives the opportunity to design and implement the microcontroller based systems.

Lectures	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s): Knowledge of programming language c and basic Digital electronics.

Course Objectives:

1. Understanding the basic principles of Microcontroller based design and development.
2. To learn low level (Assembly) as well as high level language (Embedded-C) for programming MCS-51 series microcontrollers.
3. To study various advance microcontrollers and their external interfacing techniques.
4. To develop skills and ability to select an appropriate microcontrollers and interfacing devices for various applications
5. To study software development tool such as "KEIL" used for MCS-51 series microcontrollers.

Course outcomes:

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

1. Understand concept of different types of microcontrollers.
2. Design and debug programming of microcontroller.
3. Identify and select an appropriate microcontroller as well as development tools
   for given applications.
4. 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

Microcontroller & Application
(Course Contents)

Semester-V **Examination Scheme:**
Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**
Lectures: 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**
(ESE) End Semester Exam duration: 03 Hours

Unit I **09 Hours, 16 Marks**

a. Microcontrollers & microprocessors, Embedded versus External memory devices.
b. 8-bit & 16-bit microcontrollers, Commercial microcontroller devices.
c. 8051 microcontrollers:- MCS-51 Architecture, Registers in MCS-51, 8051 pin description, 8051 connections, 8051 parallel ports, memory organization.

Unit II **09 Hours, 16 Marks**

a. 8051 Addressing modes, 8051 Instructions and simple programs, stack pointers.
b. 8051 Assembly Language Programming, Introduction to embedded-C, Concept of assembler directives, editor, linker, loader, debugger, simulator, emulator.
c. Integrated Development Environment (IDE), cross compiler, ISP. Interrupts in MCS-51, Timers and Counters, Serial Communication

Unit III **08 Hours, 16 Marks**

a. Applications of MCS-51 and 89C51 and 89C2051 microcontrollers, square wave generation, Rectangular waves, Pulse Generation, Pulse Width Modulation (PWM), Staircase Ramp Generation, Sine Wave Generation,
b. PIC Microcontrollers: Overview and features, PIC 16C6X/7X FSR (File Selection Register), PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organization, PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter (ADC)

Unit IV **08 Hours, 16 Marks**

a. Basic concepts in serial I/ Os, Interfacing of RS-232 & IEEE-484.
b. Light Emitting Diodes (LEDs), Push Buttons, Relays and Latch Connections,
c. Keyboard Interfacing, Interfacing 7-segment Displays, LCD Interfacing,
d. ADC and DAC Interfacing with 89C51 Microcontroller, 8051 Interfacing to External memory, 8051 Interfacing to the 8255.

Unit V **08 Hours, 16 Marks**

a. Introduction to PIC 16F8XX Flash Microcontroller, CISC and RISC Microcontrollers,
b. Introduction to AVR series microcontrollers. Introduction to ARM7 microcontroller.
c. Industrial Applications of Microcontrollers: Measurement Applications, Automation and Control Applications

References books:

1. Kenneth J. Ayala, '8051 Microcontroller Architecture, programming, & Applications', 2nd edition, Thomson learning.
2. Muhammad Ali Mazidi, 'The 8051 Microcontroller and Embedded Systems', Pearson Education.
3. Ajay V Deshmukh, 'Microcontrollers (Theory and Applications)', McGraw-Hill.
4. Jhon Peatman, 'Design with Microcontrollers', McGraw-Hill.
5. Jhon Peatman, 'Design with PIC Microcontrollers', Pearson Education.
6. Kenneth Hint, Daniel Tabak, 'Microcontroller: Architecture, Implementation, and programming', McGraw-Hill.
7. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Power Electronics	**PE**	

Course Description:

The course considers the basic principles of Power Electronics. This course comprises of the basic concepts, components and various circuits in Power engineering. The students can use this knowledge to understand, design and implement various power electronics circuits for industrial applications

Lectures	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s): knowledge of basic components of electronics and electrical circuits and networks at S E Level.

General Objectives:

The objective of the course is to provide students with a firm grasp of the essential principles of power electronics circuits and their classifications. The course aimed at acquiring an understanding of basic principles, operation, performance and applications of power electronics circuits. The subject is helpful in the study of technological aspects such as utilization semiconductor devices and technology in power systems, industrial drives, automation and control.

Course Outcomes:

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

1. Apply basic Knowledge of power family components for designing power control circuits.
2. Understand the working principles, classifications of various power electronic circuits.
3. Analyze the characteristics, Controls, power stages and applications of power electronic circuits.
4. Design and implement industrial applications of power electronic circuits.

Power Electronics

(Course Contents)

Semester-V **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures: 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit I: Power Family Components **09 Hours, 16 Marks**

a. Characteristics constructional details and working of Thyristor/SCR, Triac, Diac, SCS, SUS, LASCR,
b. Methods of turning on an SCR, turn-on, turn-off mechanism and characteristic, device specifications, rating and nomenclature of SCR
c. SCR triggering circuits, R, RC, pulse and UJT triggering circuits, Protection circuits for SCR.
d. Multiple connection of SCR: series operation, parallel operation, string efficiency.
e. Commutation of SCR: Natural and Forced commutation techniques.

Unit II: Rectifier and Inverter **09 Hours, 16 Marks**

a. Controlled rectifier: Single phase and three-phase controlled rectifier circuits, with R, RL
   Load, with FWD, Dual converters.
b. Inverters: Principle of operation of series inverter, parallel inverter and bridge inverter, designing of commutating component.
c. Design and operation of UPS & SMPS.

Unit III: AC Voltage Controllers and Cycloconverters **08 Hours, 16 Marks**

a. AC Voltage controllers: single-phase & three-phase with R and RL load
b. Cycloconverter: Single-phase and Three-phase Cycloconverter.
c. Induction heating and dielectric heating, Resistance welding.

Unit IV: Chopper and Speed Control of Motor **08 Hours, 16 Marks**

a. Choppers: Classification of choppers, step-up, step-down chopper, Jones chopper, Morgan chopper, and principle of operation for each method. Chopper control techniques.
b. Speed control of single- phase induction motor-using SCR and triac: various methods their circuit diagrams and working.

Unit V: Industrial Applications **09 Hours, 16 Marks**

a. Thyristor control Applications: AC and DC Static circuit breaker, Over Voltage protection circuit.
b. Zero voltage switch, Integral-cycle triggering, Time delay circuit, Soft start circuit.
c. Temperature regulator, SCR-controlled dimmer circuit, Emergency light using SCR, automatic
d. Water level indicator, automatic battery charger using SCR.

e. Ultrasonic and applications.

References:

1. Dr. P.S. Bimbhra, 'Power Electronics', Khanna Publisher.
2. M. Ramamoorty, 'An introduction to Thyristors and their applications', second edition, East-West Press.
3. M.D. Singh and K.B. Khanchandani, 'Power Electronics', Tata McGraw Hall.
4. S.K.Bhattacharya, S.Chatterjee, 'Industrial Electronics and Control' , Tata McGraw-Hill.
5. P.C.Sen, 'Power Electronics', Tata McGraw-Hill.
6. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Industrial Management and Economics	**IME**	

Course Description:

The course explores concepts of management and functioning of organizations. It introduces both theoretical concepts and empirical applications, focusing particularly on production industries. Management studies have influenced every aspect of business thinking and planning. Apart from this, it also influenced our day-today lives in the form of technological advancements. The syllabus explores the knowledge of principle of management, financial management, human resource management, operational management and marketing management.

	Hours /Week	No. of Weeks	Total Hours	Semester Credits
Lecture	3	15	42	3

Prerequisite Course(s) : knowledge basic science and Engineering .

General Objectives: This subject is designed to expose the students to fundamental concepts of management, its processes and behavioral dynamics in organizations. It will also look at recent developments in business in the context of economic theory. It also aims at making students understand concepts, philosophies, and processes of managing the marketing & financial operations of a firm.

Course Outcomes:

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

1. Understand various aspects of management.
2. Understand the concepts of human resource management, marketing management, financial management, production and operation management.
3. Estimate the financial feasibility of business and identify the various sources of financing Understand different industrial laws in views of safety, pollutions and societal developments.
4. Discharge professional duties in field of manufacturing and operational management.
5. Function on multidisciplinary teams and able to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
6. Do higher study in various new disciplines in the area of management like entrepreneurs in view of economic objectives of country, such as industrial development, regional growth, employment generation and development.

Industrial Management and Economics

(Course Contents)

Semester-V **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

UNIT I: Principles of Management **09 Hours, 16 Marks**

a. Basic Concepts: Definition, Nature, Importance, Management: Art and Science & as a Profession, Management Vs Administration, Evolution of Management: Introduction to Scientific Management by Taylor, Administrative, Management by Fayol, Contribution of Peter Drucker, Levels & Functions of Management, Forms of Business Organization.
b. Approaches to Management: Decision Theory Approach, Contingency Approach, Systems Approach.
c. Organization: Formal & Informal, Line & Staff relationship, Centralization vs. Decentralization, Span of Management, Departmentation, MBO.

UNIT II: Economics **09 Hours, 16 Marks**

a. Introduction: Meaning & Scope of Economics, Basic Theories, Law of Demand & Supply, Elasticity of Demand & Supply.
b. Consumer Theories: Meaning of Utility & Law of Diminishing Utility.
c. Cost Concepts: Opportunity Costs, Sunk Costs, Marginal Cost, Total & Variable Costs, Fixed Costs, Contribution, Law of Diminishing Return.

UNIT III: Economic appraisal techniques **08 Hours, 16 Marks**

a. Economic appraisal techniques: Long- Range and Short range Budgeting,
b. Criteria for Project Appraisal,
c. Social benefit-cost analysis,
d. Depreciation: concepts and Techniques

UNIT IV: Marketing Management **08 Hours, 16 Marks**

a. Introduction to Marketing: Concept of Market,
b. Types of Market, Definition, Nature & Scope of Marketing,
c. Marketing Approaches, Marketing Process, Functions of Marketing Management,
d. 7 P's of Marketing. Advertising media of advertising market forecasting.

UNIT V: Financial Management **08 Hours, 16 Marks**

a. Introduction to Financial Management: Meaning, Nature & Scope of Financial Management,
b. Capital Structure, Types & Sources of Finance.
c. Money Market & Capital Market, Role of Financial Institutions in Industry.

Reference Books:

1. O P Khanna, “Industrial Engineering Managements”
2. L.M.Prasad, “Principles of Management”, Himalaya Publications Ltd
3. D.N. Dwivedi, “Managerial Economics”, Vikas Publications
4. Engineering Economics : Degramo.
5. A Text Book of Economic Theory : Sammuelson
6. Philip Kotler, “Marketing Management”, Tata McGraw Hill
7. Ravi M. Kishor, “Financial Management”, Taxmann Publication.

Course Title	Short Title	Course Code
Control System Components Lab	**CSC Lab**	

This lab course provides knowledge about various control system components. This lab course provides the knowledge of transmission and controlling of the various parameters and the knowledge of various control components used for automation in industries.

Practical	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
	02	15	28	1

General Objective:

The objective of the course is to provide students with a firm grasp of the essential principles and practical aspects of control system components.

Course Outcomes:

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

1. Apply the knowledge of the control system components for controlling various Industrial parameters.
2. Able to identify, formulate and solve a problem using hydraulic, electrical & pneumatic system.
3. Analyse the process characteristics and apply suitable controller to that process.
4. Correctly select type and size of control valves for industrial use.
5. Develop the ladder diagram with combinations of electronic, pneumatic and hydraulic components for reliable automation task.
6. Discharge professional duties in the field of automation.
7. Do higher studies in field of control system components for technical advancement in the field of automation and economic developments.

Control System Components Lab

(Lab Course Contents)

Semester-V **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week

Teacher should facilitate learning following lab experiments:

1. To control any one process variable in the control loop (Flow, Level, Pressure, Or Temperature) & plot the graph of controlled variable Vs time.
2. To plot the characteristics of two-wire transmitter.
3. To plot the characteristics of I/P or P/I converter.
4. Calibration of DP transmitter for flow/ level interface.
5. Tuning of PID controller.
6. To plot the characteristics of Control valve.
7. Test and find the time constant of a given control valve.
8. Study of pneumatic components and simple pneumatic circuits.
9. Study of hydraulic components and simple hydraulic circuits.
10. Implement various ISA sequence on alarm annunciator.
11. To plot the characteristics of synchros / AC servo motor.
12. To plot the characteristics of square root extractor.
13. To plot the characteristics Pressure switch / Temperature switch.
14. Implement ladder diagram for simple Applications on PLC.
15. Study of specific/related equipment e.g. RTD, T/C, PH simulator, pressure regulator, safety devices.

Note: The term-work should include a minimum of twelve experiments from the above list.

Guide lines for ICA:

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

Course Title	Short Title	Course Code
Digital Signal Processing Lab	**DSP Lab**	

This lab course provides knowledge about Signal processing and its applications and gives the opportunity to design and implement the applications of DSP processor for biomedical, speech, image processing.

Practical	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
	02	15	28	1

General Objectives:

1. Understanding the basic principles of signal processing.
2. To Discrete time Fourier series & its properties, DFT, STFT, DWT.
3. To study and Design of FIR filter, and IIR Filter.
4. To study DSP hardware and Design Applications of DSP processor for biomedical, speech, image processing.

Course outcomes:

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

1. Ability to apply the various programming techniques on DSPs
2. Ability to design FIR and IIR filters using different techniques.
3. Ability to determine the frequency, steady state and transient response of LTI systems.
4. Ability to apply the DFT and FFT methods for various signals and determine their frequency response.

Digital Signal Processing Lab

(Lab Course Contents)

Semester-V **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Shifting and folding of digital signal.
2. Linear convolution.
3. Discrete Fourier transforms.
4. Fast Fourier transforms.
5. Design and implement FIR filter using windowing method.
6. Design and implement IIR filter using Butterwoth approximation.
7. Design and implement IIR filter using Chebeshev approximation.
8. Sine/square wave generation using TMS32OC67XX.
9. FIR filter implementation using TMS32OC67XX.
10. IIR filter implementation using TMS32OC67XX.
11. Filtering Using Discrete Wavelet transforms.

Note: The term-work should include a minimum of ten experiments from the above list.

Guide lines for ICA :

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

Guide lines for ESE:-

In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and oral in the practical examination.

Course Title	Short Title	Course Code
Microcontroller & Application Lab	**M & A Lab**	

Course Description:

In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic of microcontrollers and programming with 89c51 Microcontroller and interfacing.

Practical	Hours / Week	No. of Weeks	Total Hours	Semester Credits
	02	15	28	1

General Objectives:

1. Understanding the basic principles of Microcontroller based design and development.
2. To learn low level (Assembly) as well as high level language (Embedded-C) for programming MCS-51 series microcontrollers.
3. To study various advance microcontrollers and their external interfacing techniques.
4. To develop skills and ability to select an appropriate microcontrollers and interfacing devices for various applications
5. To study software development tool such as “KEIL” used for MCS-51 series microcontrollers.

Course Outcomes:

1. 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.
2. Ability to identify, and select an appropriate microcontroller as well as development tools for given applications.
3. 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.

Microcontroller & Application Lab
(Lab Course Contents)

Semester-V **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Write ALP for addition of 8 bit and 16-bit Numbers using IC 89C51.
2. Write ALP for Subtraction of 8 bit and 16-bit Numbers using IC 89C51.
3. Write ALP for multiplication of 8 bit and 16-bit Numbers using IC 89C51.
4. Write ALP for division of 8 bit and 16-bit Numbers using IC 89C51.
5. Write ALP for addition of 8 bit and 16-bit Numbers using IC 89C51.
6. Write ALP for 8051 Microcontroller Interfacings with LEDs.
7. Write ALP for 8051 Microcontroller Interfacings with DC Motor.
8. Write ALP for 8051 Microcontroller Interfacings with Stepper Motor.
9. Write ALP for 8051 Microcontroller Interfacings with DAC.
10. Write ALP for 8051 Microcontroller Interfacings with ADC.
11. Write ALP for 8051 Microcontroller Interfacings with Serial port Communication.
12. Write ALP for Interfacing with 7-segment Displays

Note: Lab file should consist of minimum ten experiments

Guide lines for ICA :

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

Guide lines for ESE:-

In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and oral in the practical examination.

Course Title	Short Title	Course Code
Power Electronics Lab	**PE Lab**	

Course Description:

In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic principles, characteristic, performance of power family components and power electronics circuits. It also gives the platform for designing and implementing industrial applications of power control circuits for industrial drives and control.

Practical	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
	02	15	28	1

General Objective:

The objective of the course is to provide students with a firm grasp of the essential principles of control system components.

Course Outcomes:

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

1. Apply the knowledge of the control system components for controlling various Industrial parameters.
2. Able to identify, formulate and solve a problem using hydraulic, electrical & pneumatic system.
3. Analyse the process characteristics and apply suitable controller to that process.
4. Correctly select type and size of control valves for industrial use.
5. Develop the ladder diagram with combinations of electronic, pneumatic and hydraulic components for reliable automation task.
6. Discharge professional duties in the field of automation.
7. Do higher studies in field of control system components for technical advancement in the field of automation and economic developments.

Power Electronics Lab
(Lab Course Contents)

Semester-V **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**
Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:
1. Design and plot the characteristics of SCR.
2. Design and plot the characteristics of Triac.
3. Design and implement different firing circuit for thyristor.
4. Design and implement single-phase half wave controlled rectifier.
5. Design and implement single-phase full wave controlled rectifier.
6. Design and implement different commutation circuits.
7. Design and implement series inverter.
8. Design and implement parallel inverter.
9. Design and implement Single phase Cycloconverter.
10. Design and implement step-up chopper.
11. Design and implement step-down chopper.
12. Design and implement SCR Controlled dimmer circuit.
13. Design and implement AC/DC Universal motor speed control using SCR.
14. Design and implement AC/DC Universal motor speed control using Triac.

Note: Lab file should consist of minimum twelve experiments

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

Guide lines for ESE:-
In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work , performance and oral in the practical examination.

Course Title	Short Title	Course Code
Electronics Workshop (LAB)	**E W**	

Course Description:

In this laboratory, course emphasis on imparting the practical knowledge and understanding of PCB Design and Manufacturing. Use of latest available software for PCB design. Understand and do practices for laying components, soldering and testing of Single sided PCB

	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
Theory	01	15	14	02
Practical	02	15	28	

General Objective:

The objective of the course is to provide knowledge about practical practices used in electrical engineering. This course will help students to use various tools for measurement and testing of electrical apparatus. The subject provides scope for practical applications of electrical engineering. The course will also help students to use and implement efficient and techno commercial aspect of maintenance and installation.

Course Outcomes:

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

1. Understand various electrical symbols and their use in electrical electronics drawing.
2. Familiar with the safety precautions and practices while working in industrial and domestic premises.
3. Understand various maintenance schemes such as preventive, breakdown maintenance.
4. Select correct size and type of cables and wires for different applications.
5. Use different types of measuring instrument and instrumentation and testing equipments.
6. Discharge the professional duties in technical field of maintenance and automation.

Electronics Workshop (LAB)
(Course Contents)

Semester-V **Examination Scheme:**
Teaching Scheme:
Lectures : 1 Hrs/Week

14 Hours

Printed circuit board design guidelines: general components layout scheme, grid system, PCB size mechanical stress, design rules for analog and digital circuit PCB, single, multi layer and SMD boards, Artwork CAD packages, Plating Process, Etching process, PCB Drilling, Soldering techniques.

Electronics Workshop (LAB)
(Lab Course Contents)

Semester: V **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 50Marks**
Practical: 2 Hrs/Week

The study of following topics is expected in the electronics workshop.

1. Design and Fabrication of PCB (printed circuit boards) using any PCB design software.
2. Layout of circuit using standard Layout tool (Orcad / Protel / CADstar / Pads / Ultiboard etc) should be designed and PCB making process should be carried out.
3. Study of different tools required in electronic workshop (e.g. striper, cutter, nose pliers, crimping tools, drilling machine, tube bender, pipe cutters, etc.)
4. Testing of different electronic components (e.g. resistor, capacitor, inductor, diodes, Transistors, etc).
5. Study of different auxiliary electronic/electrical components and different cables (e.g. lugs, ferrules, glands, relays, contractors, Audio/Microphone cables, ribbon cables, data transmission cables, power cables, Fiber optic cables, video/TV cable etc)

Note: The term-work should include a minimum of eight assignments and final PCB Manufacturing from the above topics.

Guide lines for ICA:
ICA shall be based on continuous evaluation of student performance throughout semester and Practical fabrication of PCB which the group of students fabricated and submitted by them.

Course Title	Short Title	Course Code
Industrial Training/EDP/Special Study	**IT/EDP/SS**	

Course Description:

Industrial training and special study is very essential for understanding the latest advancement in Instrumentation engineering. It makes bridge between theoretical knowledge and its implementation. The industrial training provides platform to understand general organization and its functions.

Industrial Training	Semester Credits
Two Weeks Industrial Training/EDP/ Special Study	**2**

Course Objectives:

The objective of industrial training is to prepare students to work on multidisciplinary team. Student will be able to understand the use of modern tools and technique for Design, Installation and maintenance in Instrumentation systems.

Course outcomes:

Upon successful completion of industrial training/special study students will be able to:

1. Understand basic organizational structure of industry.
2. Work on multidisciplinary teams and understand the impact of engineering solutions in a global, economic, environmental, and societal context.
3. To analyze the different types of Case studies and Estimate the financial feasibility of project.
4. To develop Innovative ideas and implement the theoretical concepts in practical fields.
5. Use latest testing and measuring instrument and safety precaution at work place.
6. Communicate effectively and able to write detailed project report.

Industrial Training/EDP/Special Study

(Course Content)

Semester: V **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25Marks**

Industrial Training

- Student shall undergo industrial training for a minimum period of **two weeks** during summer vacations between fourth semester and fifth semester.
- The industry in which industrial training is taken should be a medium or large scale industry
- The paper bound report on training must be submitted by the student in the beginning of Fifth semester along with a certificate from the company where the student took training.
- Every student should write the report separately.
- Institute / Department/T&P Cell have to assist the students for finding Industries for the training.
- Students must take prior permission from Department before joining for Industrial Training.

OR

EDP (Entrepreneurship Development Program)

- Student has to participate in Entrepreneurship Development Program for a minimum period of **One week** during summer vacations between fourth semester and fifth semester.
- Every student must submit the paper bound report based on the program in the beginning of Fifth semester along with a certificate (Course / Program completion) from the program organizers.
- Every student should write the report separately.
- Institute / Department may arrange Entrepreneurship Development Program at their campus.
- Students must take prior permission from Department before attending any Entrepreneurship Development Program.

OR

Special Study

- Student has to submit name of three topics of his interest to the department.
- Special study in a group shall not be allowed.
- The three-member committee appointed by Head of Department shall allot one topic out of the three topics submitted by the student.
- Every student must submit the paper bound report based on special study at the end of Firth semester.
- Department should allot guide to all such students, for monitoring their progress

and guide them for literature survey / report writing etc.

- Evaluation of special study shall be done based on presentation made by student, followed by brief question answer session.

Evaluation of Industrial Training / EDP / Special Study

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the training / EDP / Special study and based on knowledge / skill acquired by the student. The three-member committee appointed by Head of Department shall assess the reports and award marks based on following:

(a) Report	10 marks.
(b) Presentation	10 marks.
(c) Viva-voce at the time of presentation	05 marks.
Total:	**25 marks.**

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Third Year Instrumentation Engineering

Faculty of Engineering and Technology

COURSE OUTLINE

SEMESTER –VI

W.E.F 2014 – 2015

Course Title	Short Title	Course Code
Digital Control System	**DCS**	

Course Description:

This course provides knowledge about Discrete time Control system and components. It also provides the Knowledge State space Analysis, Representation and useful transformations in state space analysis and design.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	3	15	42	3

Prerequisite Course(s): Knowledge of Control systems at SE level & Control system components

General Objectives:

1. An ability to analyze the requirements of Discrete Control systems.
2. An ability to design of Discrete Time Control System by conventional methods.
3. An ability to design State space representation of discrete time systems
4. An ability to estimate, analyze, improve the Stability.

Course Outcomes:

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

1. Analyze the requirements of Discrete Control systems.
2. Design Discrete Time Control System by conventional methods.
3. Estimate, analyze, improve the Stability of the systems.

Digital Control System

(Course Contents)

Semester-VI **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit-I: Introduction to Discrete-Time Control Systems: 09 Hours, 16 Marks

a. Introduction
b. Basic building blocks of Discrete time Control system
c. Quantization and Quantization Error
d. Sampling theorem, Z transform applications for solving differential equations

Unit-II: Z plane Analysis of Discrete-time Control Systems: 08 Hours, 16 Marks

a. Introduction
b. Impulse Sampling and Data Hold
c. Transfer function of Zero Order Hold and First Order Hold.
d. Pulse Transfer Function

Unit-III: Design of Discrete Time Control System by conventional methods: 09 Hours, 16 Marks

a. Introduction
b. Mapping between the S plane and Z plane.
c. Stability analysis in Z-plane, Jury stability criterion, Bilinear transformations
d. Digital Controller Design using Analytical Design Method

Unit-IV: State Space Analysis of Discrete Time Control System 08 Hours, 16 Marks

a. State space representation of discrete time systems
b. Solution of discrete time state space equations
c. Pulse transfer function matrix
d. Discretization of continuous time state space equations
e. Similarity transformations.

Unit-V: Pole Placement and Observer Design 08 Hours, 16 Marks

a. Concept of Controllability and Observability
b. Useful transformations in state space analysis and design
c. Stability improvement by state feedback, Design via pole placement, State observers.
d. Quadratic Optmal Control
e. Stedy-StateQuadratic Optmal Control

Text Books

1. K. Ogata, “Discrete Time Control systems” Prentice Hall, Second Edition,2003.
2. M. Gopal, “Digital Control and State Variable Methods” Tata McGraw Hill, 2003.

Reference Books

1. G.F.Franklin, J.David Powell, “Digital control of Dynamic Systems”, Michael Workman 3rd Edition, Addison Wesley, 2000.
2. M. Gopal, “Digital Control Engineering”, Wiley Eastern Ltd, 1989.
3. Kannan Moudgalya, “Digital Control”, John Wiley and Sons, 2007.
4. Forsytheand W. and Goodall R.N, “ Digital Control” McMillan,1991.
5. Contantine H. Houpis and Gary B. Lamont, “Digital Control Systems”, Second Edition, McGraw-Hill International, 2002.

Course Title Short Title Course Code

Data Communication and Telemetry

Course Description:

This course provides knowledge about the communication system, waves and navigation techniques. It also emphasizes on use and understanding of Digital modulation techniques along with Analog and digital telemetry systems.

Lecture	Hours per Week	No. of Weeks	Total Hours	Semester Credits
	3	15	42	3

Prerequisite Course(s): Knowledge of basic Electronics at SE level .

General Objectives:

1. Understand the communication system, waves and navigation techniques.
2. Identify and apply the different modulation techniques.
3. Introduce to digital modulation techniques.
4. Familiarize with fibre optics communication.

Course Outcomes:

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

1. Understand the communication system, waves and navigation techniques.
2. Apply the different modulation techniques to the Signals.
3. Understand requirements of digital modulation techniques and its implementation
4. Use different telemetry systems.

Data Communication and Telemetry

(Course Contents)

Semester-VI **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit I: Elements of communication system **09 Hours, 16 Marks**

- **a.** Need for modulation,
- **b.** Amplitude modulation and detection,
- **c.** Generation and detection of DSB-SC, SSB and vestigial side band modulation,
- **d.** Carrier acquisition.
- **e.** AM transmitters and receivers.

Unit II: Modulation **09 Hours, 16 Marks**

- **a.** Introduction, sampling process
- **b.** Pulse width modulation and Pulse Position Modulation.
- **c.** Waveform coding Techniques: Discrtization in time and amplitude
- **d.** Quantization process, quantization noise,
- **e.** Pulse code Modulation, Differential Pulse code Modulation
- **f.** Delta Modulation and Adaptive Delta Modulation.

Unit III: Digital Modulation Techniques **08 Hours, 16 Marks**

- **a.** Types of digital modulation,
- **b.** waveforms for amplitude, frequency and phase shift keying
- **c.** Methods of generation of coherent and non-coherent
- **d.** ASK, FSK and PSK, comparison of above digital techniques.

Unit IV: Time Division Multiplexing **08 Hours, 16 Marks**

- **a.** Fundamentals,TDM and FDM
- **b.** Introduction to TDMA,FDMA and CDMA.
- **c.** Introduction to Information Theory: Measure of information
- **d.** Entropy & Information rate, channel capacity
- **e.** Hartley Shannan law, Huffman coding, shannan Fano coding.

Unit V: Telemetry **08 Hours, 16 Marks**

- **a.** Introduction to telemetry and telecontrol-telemetry links-telemetry error
- **b.** Remote Sensor. Classification of signals-their suitability for telemetry
- **c.** Analog and digital telemetry.
- **d.** Landline telemetry-mechanical,
- **e.** Pneumatic and electrical systems – industrial telemetry.
- **f.** Application of negative feedback for pneumatic and wire telemetry systems.

Reference Books:

1. Simon Haykin," Communication Systems" John Wiley & Sons 4th Edition
2. G.Kennedy and B. Davis,"Electronic Communication Systems" 4th Edition, Tata McGraw Hill
3. B.P. Lthi, "Modern Analog & Digital Communication Systems" Oxford University Press.
4. Taub & Schilling, "Communication System: Analog and Digital" Tata Mc Graw Hill
5. R.P.Singh & S.D. Sapre, "Communication Systems Analog and Digital" Tata McGraw Hill.
6. Telemetry Principles by Patranabis

Course Title	Short Title	Course Code
Process Instrumentation	**PI**	

Course Description:

This course provides knowledge about different analytical methods and Instruments used for chemical analysis and role of Instrumentation in chemical analysis.

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	3	15	42	3

Prerequisite Course(s): Basic knowledge of control system and control actions.

General Objectives:

1. To understand principles of elements in the control loop
2. To appreciate the properties of different control loops and suggest suitable control for it.
3. To develop problem-solving skills applicable to real-world problems in the process industries.

Course Outcome:

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

4. Summarize and classify characteristics of various control loops
5. Design and apply appropriate control for different control loops.
6. Familiarize with the advances in process instrumentation.

Process Instrumentation

(Course Contents)

Semester-VI **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit I **09 Hours, 16 Marks**

a. Process characteristics: Types of Processes (Dead time, single and multicapacity, Self and non-self regulating, interacting and non-interacting, linear and non-linear processes).
b. Process gains, process reaction curve, process time constant and constant step analysis method for finding time constant, Dead time.
c. Dynamic elements in control loops. PID control of processes. Process simulators.

Unit II **09 Hours, 16 Marks**

a. Analysis and properties of some common loops: Flow, pressure level, temperature, composition, pH etc.
b. Linear and non linear controllers, review of PID with limitations(offset, saturation in D, & reset windup) rate before reset, PID variations, and tuning,
c. Digital controller (position and velocity algorithms, effect of sampling time) hardware structures, features and specification.
d. Single loop and multiloop controllers and the application programs, Non-linear controller-two state, three state, proportional time, dual mode, optimal switching.

Unit III **08 Hours, 16 Marks**

a. Multi-loop and multivariable process control systems: Feedback, Feed forward Control, cascade control, ratio control, auto selective control, spit range control.
b. Predictive control systems and Adaptive control systems.
c. Interaction and decoupling, Relative gain analysis, procedure to calculate relative gain, and its applications.

Unit IV **08 Hours, 16 Marks**

a. Boiler instrumentation and Optimization, boiler equipment safety interlocks,
b. Boiler efficiency and dynamics, boiler controls, combustion control, air to fuel ratio control.
c. 3 element drum level control, steam pressure control, steam temperature control.
d. Burner management and control boiler optimization.
e. Furnace control of heat exchangers, steam and fired heaters control.
f. Reboilers, vaporization and condensers.

Unit V **08 Hours, 16 Marks**

a. Instrumentation schemes for Pumps and compressor controls,
b. Instrumentation schemes for multi effect evaporators, dryer, chemical reactors, cooling tower,
c. Instrumentation schemes for rolling mill, extruder, crystallizer, chiller and ORP control.

References Books:

1. F. G. Process, "Control Systems", (TMH)
2. B.G. Liptak , "Process Control," (Chilton)
3. Krishna kant , "Computer Based Industrial Control", (PHI)
4. F. G. Shinskey, "Feedback Controllers Tuning, Applications and Designing", (TMH)
5. Tuning of PID controllers (ISA)
6. G.Stephanopoulos , "Chemical Process Control", (PHI).
7. Considine "Process Instrumentation and Control Handbook", (MGH).
8. C. D. Johnson , "Process Control Instrumentation", (PHI)
9. Continuous process control (ISA)
10. Smart sensors ISA
11. Statistical process Control ISA
12. Multivariable process control ISA

Course Title	Short Title	Course Code
Analytical Instrumentation	**AI**	

Course Description: This course provides knowledge about different analytical methods and Instruments used for chemical analysis and role of Instrumentation in chemical analysis

Lecture	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	3	15	42	3

Prerequisite Course(s): Basic knowledge of measurement system and Its characteristics.

General Objectives:

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

Course Outcome:

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

1. Summarize and classify capabilities and limitations of analytical instruments.
2. Ability to select and use an analytical instrument in the physical, chemical and biological world and appreciate the role of instrumentation.
3. Familiarize with the advances in analytical instrumentation.

Analytical Instrumentation
(Course Content)

Semester-VI **Examination Scheme:**
Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**
Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**
(ESE) End Semester Exam duration: 03 Hours

Unit I: **09 Hours, 16 Marks**

a. **Introduction to classical and instrumental methods for chemical analysis**: comparison of these methods, classification of Instrumental methods (spectral, electroanalytical and separative methods) U.V. 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.

Unit II: **09 Hours, 16 Marks**

a. **IR spectroscopy**: Instrumentation, sources, detectors, FTIR. Raman Spectrometry; Raman effect, Raman spectrometer components, LASER Raman spectrophotometer.
b. **Flame photometry**: Principle, Instrumentation constructional details, fuel gases, atomizer, burner, optical system, Recording system. Interferences in Flame photometry, Applications
c. **Atomic Absorption Spectroscopy(AAS**): Principle, instrumentation-hollow cathode lamps, burners and flames, plasma excitation sources, optical and electronic systems. Interferences in AAS, Applications

Unit III: **08 Hours, 16 Marks**

a. **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;Electron spin resonance (ESR) spectrometry – principle, constructional details.
b. **Fluorimeters and phosphorimeters**; principle, single and double beam filter fluorimeter, ratio fluorimeter, spectrofluorimeter, microprocessor-based instruments, phosphorescence spectrometer.

Unit IV: **08 Hours, 16 Marks**

a. **Mass spectrometry**: basic mass spectrometer components, types, magnetic deflection type, time of flight, radio frequency, double focusing, quadrupole type ,Gas chromatograph mass spectro-meter, GCMS Sy stems; resolution of mass spectrometer, applications.
b. **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), densitometer.
c. **Radio chemical instrumentation**: Radio chemical methods, radiation detectors – ionization chamber, Geiger Muller counter, proportional counter, Scintillation counter, Semiconductor detectors, pulse height analyzer. X-ray spectrometry: X-ray spectrum, instrumentation for X-ray spectrometry, X-ray diffract meters, X-ray absorption meter.

Unit V: **08 Hours, 16 Marks**

a. **Gas and liquid chromatography**: Classification; basic parts of gas chromatograph – carrier gas, sample injection system, chromatographic column, thermal compartment, temperature programming, dual column system, detectors-thermal conductivity, flame ionization, electron capture, Argon ionization detector, recording instruments; introduction to liquid chromatography and its classification, HPLC , Introduction to optical densitometer, Refractometry.
b. **Different types of gas analyzers:** oxygen, carbon monoxide, carbon dioxide, Nitrogen analyzer, gas density analyzers. Environment monitoring system.

Reference Books:

1. R.S. Khandpur, 'Handbook of Analytical instruments', Tata McGraw-Hill.
2. D.Patranabis, 'Principles of Industrial instrumentation', second edition, Tata McGraw-Hill.
3. Willard, Merrit, Eean, 'Instrumental methods of Analysis',
4. E.W.Ewing , 'Instrumental Methods of Chemical Analysis'.
5. Robert D. Braun , 'Introduction to Instrumental Analysis'.
6. B.K.Sharma, 'Instrumental Methods of Chemical Analysis', goyal publications
7. S.G.Skoog , 'Principles of Instrumental Analysis', Thomson.

Course Title	Short Title	Course Code
Project Planning & Estimation	**P.P.E.**	

Course Description:

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

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	3	15	42	3

Prerequisite Course(s): Knowledge of SE level & TE level.

General Objective:

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

Learning Outcomes:

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

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

Project Planning & Estimation
(Course contents)

Semester-VI **Examination Scheme:**
Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**
Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**
(ESE) End Semester Exam duration: 03 Hours

Unit- I: Introduction **9 Hours, 16 Marks**

a. Definition of Project; Purpose, scope, time, quantity, and organization structure.
b. Degree of Automation, Manpower considerations.
c. Inter-department and inter organization interactions.
d. Process flow sheets, P & I diagrams, Interlock diagrams and Instrument Index Sheets.
e. Instrumentation standards and practices, Legends and Symbols, Instrumentation symbols and Identifications (ANSI/ISA-5.1)
f. Plant layout, General arrangement drawing (Plans and Elevations)

Unit- II: I & C Documentation and Cable Engineering **9 Hours, 16 Marks**

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

Unit- III: Procurement Activities and Construction Activities
8 Hours, 16 Marks

a. Vendor registration, tendering and bidding process, bid evaluation,
b. Purchase order, vendor documents, and drawing and reports as necessary at above activities.
c. Site conditions and planning, front availability, Installation and commissioning activities and documents required/generated at this stage
d. On-site inspection and testing (SAT) installation sketches, bill of material, contracting, cold commissioning and hot commissioning, CAT (Customer Acceptance Test), Perform trials and final handover.
e. Control console, centers, panels and indicators: Types, Design, Inspection, and specification. Intelligent operator interface (IOI).
f. Field bus Wiring: Terminator, Power Conditioners, Spurs, Segments, and repeaters.
g. Networking: Hubs, routers, LAN cards, and Cat cables.

Unit- IV: Project Management **8 Hours, 16 Marks**

a. Process planning and scheduling.
b. Management: importance, characteristics, principles and levels of management.
c. Controlling, Directing, project authority, responsibility, Accountability, interpersonal influences and standard communication format, project Reviews.
d. The statement of work (SOW), Project specifications, milestone schedules, work breakdown structures, cost breakdown structure and the planning cycle.
e. Overview planning and execution mode (conceptual focus, design, implementation, operation and support transition).

Unit- V: Cost Management, PERT and CPM **8 Hours, 16 Marks**

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

References:

1. Andrew and Williams , "Applied Instrumentation in Process Industries",Gulf Publishing.
2. Liptak , "Process Control Instruments Engineer's Handbook", Chilton.
3. Hardlod Kerzner, "Project Management System Approach To Planning Scheduling and Controlling, 5th edition, Van Nostrand Reinhold Publishing.
4. John Bacon, " Management systems," (ISA).
5. T.G. Fisher, "Batch Control Systems", (ISA).
6. John Bacon, "Instrument installation project management", (ISA).

Course Title	Short Title	Course Code
Digital Control System (LAB)	**DCS Lab**	

Course Description:

In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic principles and performance of digital control systems.

Practical	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
	02	15	28	1

Prerequisite Course(s): Knowledge of Control systems at SE level & Control system.

General Objectives:

1. To Use Control System toolbox of Matlab.
2. To Find the Response and stability analysis of the Discrete Time Control System for different standard input signals.
3. To study State Space Analysis of Control Systems.
4. To investigate the controllability and observability of a system.

Course Outcomes:

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

1. Use and handle various blocks and instructions in control system toolbox of Matlab.
2. Plot response and stability analysis of the Discrete Time Control System for different standard signals.
3. Design and investigate State Space Analysis of Control Systems.
4. Find controllability and observability of a system.

Digital Control System (LAB)
(Lab Course Contents)

Semester-VI **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**
Practical: 2 Hrs/Week **(ESE) End Semester Examination (PR):25 Marks**

Teacher should facilitate learning following lab experiments:

1. Find the Response of the Discrete Time Control System for any two standard inputs.
2. State Transition Matrix
3. Conversion of Continuous Time to Discrete Time Systems
4. Transient response of Control System.
5. State Space Analysis of Control Systems.
6. Pulse Transfer Function.
7. Discretization of continuous time state equation.
8. Investigation of the controllability and Observability of a system.
9. Design of control system using pole placement technique.
10. Design of State observer.
11. Design of Discrete Time Control System based on minimization of quadratic performance index.

Note: Perform experiments using MATLAB . Lab file should consist of minimum Eight experiments

Guide lines for ICA:
ICA shall be based on continuous evaluation of student performance throughout semester and Practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-
In ESE the student may be asked to perform any one practical . Evaluation will be based on paper work , performance and oral in the practical examination.

Course Title	Short Title	Course Code
Process Instrumentation (LAB)	**PI Lab**	

Course Description:

In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic principles, and performance Process Equipments and control systems. It also includes study of different control loops

Practical	**Hours / Week**	**No. o f Weeks**	**Total Hours**	**Semester Credits**
	02	15	28	1

Prerequisite Course(s): Second year Instrumentation Engineering.

General Objectives:

1. To understand various control Schemes and techniques in process control.
2. To understand the process characteristics and their classification.
3. To learn different control loops and propose proper control scheme for it.

Course Outcomes:

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

1. Distinguish various control techniques to processes.
2. Understand the process characteristics, collect the data from the system and interpret the classification of the system.
3. Identify control loops in a given process and discuss appropriate control strategy.

Process Instrumentation (LAB)

(Lab Course Contents)

Semester-V I **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(OR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Find the time constant of single capacity / Multi-capacity process by graphical methods.
2. Study of interacting and non-interacting process.
3. Study the analysis of flow / level /pressure control loop.
4. Study of temperature control loop
5. Tuning the PID controller for any one control loop.
6. Implementation of cascade controller.
7. Design and implementation ratio controller
8. Study of Ratio control/ Selective control
9. Study of non linear control elements.

Note: Lab file should consist of minimum eight experiments

Guide lines for ICA :

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

Guide lines for ESE:-

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

Course Title	Short Title	Course **Code**
Analytical Instrumentation (LAB)	**AI Lab**	

Course Description:
In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic principles and performance of working of Analytical Instruments.

Practical	**Hours / Week**	**No. o f Weeks**	**Total Hours**	**Semester Credits**
	02	15	28	1

Prerequisite Course(s): Second year Instrumentation Engineering.

General Objectives:

1. To Understand and the operating principle and use of analytical instruments.
2. Learn spectroscopes and perform simple analytical procedures on a given sample using colorimeter and UV-Visible spectrophotometer.
3. Study and use chromatography for given sample analysis.

Course Outcomes:

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

1. Understand and appreciate the safe use of analytical instruments.
2. Critique spectroscopy and perform simple analytical procedures on a given sample using colorimeter and UV-Visible spectrophotometer.
3. Identify, formulate and solve a real world problem based on chromatography analysis

Analytical Instrumentation (LAB)
(Lab Course Contents)

Semester: VI **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25Marks**
Practical: 2 Hrs/Week

Teacher should facilitate learning following lab experiments:

1. Study of filter photometer.
2. Study of flame photometer.
3. Study of Densitometer.
4. Study of spectrophotometer (visible and infra-red region)
5. Study of single beam spectrophotometer for UV/VIS range.
6. Study of double beam spectrophotometer for UV/VIS range.
7. Study of mass spectrometers.
8. Study of gas chromatographs.
9. Study of liquid chromatographs.
10. Study of N.M.R. and E.S.R. spectrometer.
11. Study of atomic absorption spectrophotometer.
12. Study of Refractometer.

Note: Lab file should consist of minimum ten experiments

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

Course Title	Short Title	Course Code
Virtual Instrumentation LAB	**VI Lab**	

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 of real time systems for Measurement and control. It also gives the platform for designing and implementing industrial automation applications.

Practical	**Hours / Week**	**No. o f Weeks**	**Total Hours**	**Semester Credits**
	02	15	28	1

Prerequisite Course(s): Second year Engineering and understanding of Computer programming.

General 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.

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

Virtual Instrumentation LAB
(Lab Course Contents)

Semester-VI **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**
Practical : 2 Hrs/Week **(ESE) End Semester Examination Practical (PR) : 25Marks**

Teacher should facilitate learning following lab experiments:

1. To study programming for virtual instrument Using LabVIEW
2. Develop a LabVIEW program for conversion
    - 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 show it on graph
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
    i. Array with Array
    ii. Array with Number
    iii. Cluster with Number
7. Develop a LabVIEW program for addition of
    i. Matrix with Matrix
8. Waveform with Number Develop a LabView program using case 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 etc.
11. Develop a LabVIEW based Temperature Measurement and Control System.
12. Develop a LabVIEW based Temperature Measurement and Control System.

Note: Lab file should consist of minimum ten experiments

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

Guide lines for ESE:-
In ESE the student may be asked to perform any one practical . Evaluation will be based on paper work , performance and oral in the practical examination.

Course Title	Short Title	Course Code
Minor Project	**MP**	

Course Description:

In this course emphasis should be given on selection of a proper project which may be hardware or software based. Generally a hardware software combination should be **preferred so as to** achieve final objective. Students are required to use microprocessor, Microcontroller or PC as a major element in their project.

Practical	**Hours / Week**	**No. o f Weeks**	**Total Hours**	**Semester Credits**
	02	15	28	2

Prerequisite Course(s): Knowledge of Basics of circuit designing, Microcontroller and computer programming.

General Objectives: The objectives of project are to develop ability to work in group. The scope of work is design and fabricate a system consist of analog and/or digital circuit so as to achieve a certain objective.

Course Outcomes:

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

1. Apply knowledge of mathematics, science, and engineering.
2. Design and conduct experiments, as well as to analyze and interpret data.
3. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
4. Identify, formulate, and solve engineering problems by understanding professional and ethical responsibility.
5. Use the techniques, skills, modern engineering tools and software necessary for engineering practice.

Minor Project

(Lab Course Contents)

Semester-VI **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 50 Marks**

Practical : 2 Hrs/Week

- Every student shall undertake the Minor Project in semester VI. It is expected that the broad area of major project shall be finalized by the student in the beginning of the VI semester and Minor project undertaken may be a part of Major Project.
- Each student shall work on an approved project, a group of **05 students (maximum)** shall be allotted for the each minor project and same group may be continued for major project.
- Minor project may involve fabrication, design or investigation of a technical problem that may take design, experimental or analytical character or combine element of these areas. The project work shall involve sufficient work so that students get acquainted with different aspects of fabrication, design or analysis.
- Each student is required to maintain separate log book for documenting various activities of minor project.
- The three-member committee appointed by Head of the department shall be constituted for finalizing the topics of minor project. Maximum four minor project groups shall be assigned to one teaching staff.
- **Guide lines for ICA :** Assessment of the project for award of ICA marks shall be done jointly by the guide and departmental committee as per the guidelines given in **Table-A.**

Assessment of Minor Project

Name of the Project: _____

Name of the Guide: _____

Table-A

SN	Exam Seat No	Name of Student	Project Selection	Documentation	Design /Simulation/Logic	PCB/hardware/programming	Result Verification	Presentation	Total
			5	10	10	10	10	5	50

Seminar-I

(Course Contents)

Semester-VI **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week

1. For Seminar-I every student will individually study a topic assigned to him / her and submit a report and shall deliver a short lecture / Seminar on the topic during the term.
2. The three-member committee appointed by Head of the department shall be constituted for finalizing the topics of Seminar-I. Seminar shall be related state of the art topic of his choice approved by the committee.
3. Seminar topic should not be repeated and registration of the same shall be done on first come first serve basis.
4. Topic of Seminar shall be registered within a two week from commencement of VI Semester and shall be approved by the committee.
5. Maximum six seminar supervision shall be allotted to each teacher.
6. At the end of semester, student should submit the seminar report (paper bound copy)in following format:
    a. Size of report shall be of minimum 25 pages.
    b. Student should preferably refer minimum five reference books / magazines/standard research papers.
    c. Format of report
        i. Introduction.
        ii. Literature survey.
        iii. Theory 1) Implementation 2) Methodology
            3) Application 4) Advantages, Disadvantages.
        iv. Future scope.
        v. Conclusion.

ASSESSMENT OF SEMINAR-I

Guide lines for ICA : Assessment of the Seminar-I for award of ICA marks shall be done by the guide and a departmental committee jointly, as per the guidelines given in **Table-B**

Title of Seminar: _____

Name of Guide: _____

Table-B

SN	Exam Seat No	Name of Student	Topic Selection	Literature survey	Report writing	Depth of understanding	Presentation	Total
			5	5	5	5	5	25