University of Pune

Structure for M. E. Instrumentation and Control - Process Instrumentation 2013 course

SEMESTER- I

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		TH/ PR	Paper		TW	Oral/ Presentation	Total	
			In Semester Assessment	End semester Assessment				
506101	*Mathematical Methods in Instrumentation	4	50	50	-	-	100	4
506102	Transducer Design	4	50	50	-	-	100	4
506103	Industrial Automation	4	50	50	-	-	100	4
506104	*Research Methodology	4	50	50	-	-	100	4
506105	Elective I	5	50	50	-	-	100	5
506106	Lab Practice I	4			50	50	100	4
Total		25	250	250	50	50	600	25

SEMESTER- II

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		TH/ PR	Paper		TW	Oral/ Presentation	Total	
			In Semester Assessment	End semester Assessment				
506107	Advanced Process Control	4	50	50	-	-	100	4
506108	Embedded System Design	4	50	50	-	-	100	4
506109	Advanced Control System	4	50	50	-	-	100	4
506110	Elective II	5	50	50	-	-	100	5
506111	Lab Practice II	4			50	50	100	4
506112	Seminar I	4			50	50	100	4
Total		25	200	200	100	100	600	25

***Note: Common to Process Instrumentation & Bio- Medical Instrumentation**

SEMESTER- III

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME					CREDITS
		TH/ PR	Paper		TW	Oral/ Presentation	Total	
			In Semester Assessment	End semester Assessment				
606101	Advanced Signal Processing	4	50	50	-	-	100	4
606102	Building Automation	4	50	50	-	-	100	4
606103	Elective III	5	50	50	-	-	100	5
606104	Seminar II	4	-	-	50	50	100	4
606105	Project Stage I	8	-	-	50	50	100	8
Total		25	150	150	100	100	500	25

SEMESTER- IV

CODE	SUBJECT	TEACHING SCHEME	EXAMINATION SCHEME				CREDITS
		TH/ PR	Paper	TW	Oral/ Presentation	Total	
606106	Seminar III	5	-	50	50	100	5
606107	Project Work Stage III	20	-	150	50	200	20
Total		25	-	200	100	300	25

List of the Electives:

Sr. No.	Elective-I	Elective-II	Elective-III
A	Modern Control System	Batch Process Control	Environmental Studies
B	Digital Control System	Soft Computing	Pollution Control
C	Robotics	Modelling and Optimization	Fundamentals of Disaster Management
D	Advanced Power Electronics	Computerised Process Control	Constitution of India

Elective- III- Common to Process Instrumentation & Bio- Medical Instrumentation

SEMESTER- I

506101- Mathematical Methods in Instrumentation

Teaching scheme:	**Examination Scheme:**	**Credits** : 4
Lectures: 4 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Module- I

Vector Spaces and Transformation: Vector spaces, subspace and linear dependence, concept of basis, representation, norms of vectors and orthonormalization, Linear transformations, concept of symmetry, inner products, singular value decomposition.

Module- II

Orthogonal and Unitary Transformation: Orthogonal projections, products of projections, orthogonal direct sums, Unitary and orthogonal transformations, closed subspaces and the projection theorem for Hilbert spaces.

Module- III

Numerical method for algebraic and differential equations: Least square method, Gauss-Jordon method, Gauss-Seidal method, Gauss elimination method, Newton-Raphson method, Euler's method, modified Euler's method, Runge-Kutta methods, Adam-Bash forth method

Module- IV

Basic concept of Probability: Random experiments, sample spaces, axioms of probability, conditional probability, Bayes theorem.

Module- V

Probability distributions: Probability distribution function, probability density function, Binomial, Normal, Poisson and uniform distribution

Module- VI

Mathematical expectations: Mean variance, standard deviation, moments, covariance and correlation.

References:

1. Chen C. T., 'Linear Systems: Theory & Design', (Oxford University Press New York), (1999).
2. Charles W. Curtis, 'Linear Algebra: An Introductory Approach', (Springer (India) Pvt. Ltd.), (2004).
3. Strang G., 'Linear Algebra And Its Applications'. (Thomson Brooks, Australia), (1998).
4. Lay D. C., 'Linear Algebra and Applications', (Addison Wesley, Massachusetts), (1996).
5. Gilbert Jimmie and Gilbert Linda, 'Linear Algebra and Matrix Theory', (Elsevier India Publishing Co., New Delhi), 2005.
6. Grewal B. S., 'Higher Engineering Mathematics', (Khanna Publishers, New Delhi), (2004).
7. Rajaraman V., 'Computer Oriented Numerical Methods'. (Prentice Hall of India New Delhi), (1990).
8. Murray Spiegel, John Schiller and R. Alu Srinivasan, 'Probability and Statistics', (Tata McGraw- Hill edition, New Delhi).
9. Miller I & Freund J., 'Probability & Statistics For Engineering'. (Prentice Hall Of India New Delhi), (1987).
10. Walpole R. E., Myers R. H. & Myers S. L., 'Probability & Statistics For Engineers & Scientist'.(Prentice Hall Inc. New Jercy

506102- Transducer Design

Teaching scheme:	**Examination Scheme:**	**Credits** : 4
Lectures: 4 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Module- I

Review of Fundamentals of Transducers for measurement of: Physical parameters i.e. displacement, pressures, force, Flow, stress, strain, velocity, vibration, torque, temperature, pH, conductivity, proximity sensors, Chemical parameters, Biomedical parameters i.e. pathological parameters, Detection of alpha, beta and gamma radiation

Module- II

Review of signal conditioners for: Strain Gauge Transducers, Inductive Transducers, Magnetic, Magneto-strictest, Piezo Electric Transducers, Optical Transducers, Capacitive Transducers, Vibrating wire, Review of Processors for Analogue and Digital Signals, Review of Various Input and Output Display Systems

Module- III

Design of Electromechanical Transducers for: Force, Pressure, Stress, Vibration using ,Strain-gauge, LVDT , Capacitive Elements, Optical Device, Take typical application in each design case, such as measurements for Hydraulic and Pneumatic Machinery like Turbines, Aircraft Systems and Ship Machinery.

Module- IV

Discussion of Selection Criteria for each of above cases: Design of Electromechanical Transducers for Torque, Flow and Velocity. Take typical application in each design case from Automobile for Torque, Liquid Flow for Flow and Velocity. Inclination/Tilt, Rotation and Gyration of Machinery like Winches, Earth Movers, Fork lifts, Giant Wheels, Space Craft etc. Discussion on design criteria for three component and six component dynamometers both pure mechanical and electromechanically designs to be discussed. Discussion on Multi-output (including digital) Transducers for various applications.

Module- V

Case Studies for: Chemical Sensors, Bio sensors, Gas Sensors. Discussions on Nano Sensors and MEMS applications.

Module- VI

Application of LASER for various measurements like: alignment, distance, velocimetry for convection and liquid flow, angular rotation. Applications of LASER for micromachining, printing and compact discs like CD and DVD, Weapons, welding, surface hardening, cutting, nuclear fusion.

References:

1. H K P Neubert, ' *Instrument Transducers*', (Oxford University Press) (1963)
2. Bella G Liptak, ' *Instrument Engineer' Handbook, Vol 1,2 and 3'* , 3rd edition, (CRC Press) (2002).
3. C.S. Rangan, G.R. Sharma and V.S.V. Mani *'Instrumentation Devices and Systems'* , Tata Mcgraw-Hill Publishing Company Ltd. New Delhi (1983).
4. J. Wilson, J.F.B. Hawkes, *'Laser Principles and Applications'* ,.(Prentice-Hall, New York), (1987)
5. J. Wilson, ' *Optoelectronics'* , 2nd Edition,(Prentic-Hall, India) (1999)

506103- Industrial Automation

Teaching scheme: **Examination Scheme:** **Credits** : 4

Lectures: 4 Hrs/ Week Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Module- I

Introduction to Industrial Automation: Role of automation in industries, Introduction to type of automation system, Introduction to automation tools like PAC, PLC, SCADA, DCS, Hybrid DCS with reference to automation pyramid.

Module- II

Networks in process automation: Information flow requirements, Industry Network , HART: Introduction, Design, Installation, calibration, commissioning, Foundation Fieldbus & Profibus: Introduction, Design, Calibration, Commissioning

Module- III

Programmable Logic Controllers: Introduction of Advanced PLC programming, Selection of processor, Input/output modules, Interfacing of Input/output devices, Operator Interface, OPC, study of SCADA Software, Interfacing PLC to SCADA/DCS using different communication protocols.

Module- IV

DCS: Introduction to architecture of different makes, Comparison of these architectures with automation pyramid, DCS Specifications, Plant wide database management, Security and user access management, MES, ERP Interface, Performance Criteria for DCS and other automation tools.

Module- V

Introduction to process safety : risk, risk terminologies, consequence and risk, risk measurement, Process Hazard Analysis (PHA), Hazard and operability study (HaZop), Safety Integrity Level (SIL), Introduction to IEC61511 standard for Functional safety , protection layers, Safety Instrumented System: function, architecture, safety life cycle, Application of safety system.

References:

1. Bella G Liptak, '*Instrument Engineers' Handbook - Process Software and Digital Networks, Vol '3'*, 3rd edition, (CRC Press), (2002)
2. Popovic and Bhatkar, "Distributed Computer Control For Industrial Automation" , Marcel Dekker,INC, 2005.
3. Webb and Reis, "Programmable Logic Controllers: Principles and Applications", PHI, 2009.
4. Introduction to Programmable Logic Controllers, Garry Dunning, Thomson Learning.
5. Understanding Distributed Process Systems For Control, Samuel Herb, ISA.
6. Computer Based Process control,Krishna kant,PHI
7. Mechatronics ,HMT, TMH publication

506104- Research Methodology

Teaching scheme:	**Examination Scheme:**	**Credits** : 4
Lectures: 4 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Module- I

Research Problem:

Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem

Module- II

Basic instrumentation :

Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP is collected data contains noise.

Module- III

Applied statistics :

Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis, Probable errors in the research, Error analysis

Module- IV

Modelling and prediction of performance :

Setting up a computing model to predict performance of experimental system, Multi-scale modelling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.

Module- V

Developing a Research Proposal :

Format of research proposal, Individual research proposal, Institutional proposal, Proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only, Other faculty members may attend and give suggestions relevant to topic of research

References:

1. 'Research methodology: an introduction for science & engineering students', by Stuart Melville and Wayne Goddard
2. 'Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville
3. 'Research Methodology: A Step by Step Guide for Beginners', by Ranjit Kumar, 2nd Edition
4. 'Research Methodology: Methods and Trends', by Dr. C. R. Kothari
5. 'Operational Research' by Dr. S.D. Sharma, Kedar Nath Ram Nath & co.
6. Software Engineering by Pressman

506105- A- Modern Control Theory

Teaching scheme:	**Examination Scheme:**	**Credits** : 5
Lectures: 5 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Elective- I

Module- I

Linear vector spaces and linear operators: Fields, vectors and vector spaces, Linear dependence, Dimension of linear space, The notion of bases, Linear transformation and matrices, Scalar product and norms, Quadratic function and definite matrices, vector and matrix norms, Gram determinant, Solution of linear algebraic equation: Range space, Rank, Null space and nullity of a matrix, Homogenous and nonhomogeneous equations, Eigenvalues and Eigenvectors and a canonical form representation of linear operators, Functions of square matrix: Caley- Hamilton theorem.

Module- II

Introduction to control systems: Ordinary differential equation, Transfer function, Pole zero concepts, effect of pole location on performance specification. System models in state space, canonical model, MIMO systems, solution of state equation, stability of systems in state space.

Module- III

State Space Description for multivariable Control Systems: The concept of state and state models, State equations for dynamic systems, State equations using phase, physical and canonical variables, Plant models of some illustrative control systems, State space representation and realization of transfer matrices, Minimal realization, Solution of state equation.

Module- IV

Control Systems Analysis: Concept of Controllability and Reachability, Observability and Constructability, Controllable and Uncontrollable subspace, Observable and unobservable subspace, Controllability and Observability tests: Kalman's test matrix, Gilbert's test, Controllability and observability canonical forms, Stability and stabilizability theory.

Module- V

State Space Design: Linear state variable feedback: The effect of state feedback on controllability and observability, Necessary and Sufficient condition for arbitrary pole placement, Ackermann's formula for pole placement, State observers: Full-order state observers and minimum order observers, Study of some physical plant for analysis and design.

References:

1. C. T. Chen, Linear System Theory and Design, Holt, Rinehart and Winston, New York, 1984.
2. T. Kailath, Linear Systems, Prentice-Hall, Englewood Cliff's, NJ, 1980.
3. M. Gopal, Modern Control System Theory, Second Edition, New Age International (P) Limited, New Delhi, 1996
4. W. A. Wolovich, Linear Multivariable Systems, Springer-Verlag, and Berlin, 1974.
5. P. J. Antsaklis and A. N. Michel, Linear Systems, McGraw-Hill International Editions, 1998.
6. K. Ogata, Modern Control Engineering, Third Edition, Prentice-Hall of India, New Delhi, 1997

506105- B- Digital Control System

Teaching scheme:	**Examination Scheme:**	**Credits** : 5
Lectures: 5 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Elective- I

Module- I

Introduction to Discrete Time control Systems: Digital Control Systems, S plane to Z plane Mapping, Z transform approach for solution of difference Equations, Basic routes to the design of digital Controllers. Z plane Specification of Control system design, Transient and steady state Analysis.

Module- II

Design of Discrete Time Control Systems: Z domain Root Locus, Z domain digital control system design: Z domain contours, Proportional control design in Z domains, Design based on Frequency Response method, Digital implementation of analog controllers design: Differencing Method, Bilinear transformation, Pole zero matching, Empirical digital PID controller tuning. Direct digital controller design in Z domain, Finite settling time design, and Deadbeat control.

Module- III

State Space Analysis of Discrete time control system: Discretization of Continuous time state space Equation, Similarity Transformation, Pulse transfer function Matrix, solution of state difference equations, Controllability and stabilizability, Observability and detect ability, effect of sampling on Controllability and observability, Multivariable systems.

Module- IV

Design concept in state space: Stability of State–Space Realizations, Useful transformation in state space Analysis and design, Pole placement using different method, State Observers and designs, Deadbeat control by state feedback and deadbeat observers, Servo systems.

Module- V

Optimal Control: Constrained Optimization, Unconstrained optimization, Concept of Optimal Control, Quadratic Performance index, steady state optimal Control, Optimal state Regulators, linear quadratic Regulator, free final state, Hamiltonian Systems.

References:

1. Discrete Time Control systems by K. Ogata, Prentice Hall, Second Edition, 2003.
2. Digital Control and State Variable Methods by M. Gopal, Tata McGraw Hill, 2003.
3. Digital control of Dynamic Systems by G.F.Franklin, J.David Powell, Michael Workman 3rd Edition, Addison Wesley.
4. Digital Control by Kannan Moudgalya, John Wiley and Sons, 2007.
5. Digital Control Systems by Contantine H. Houpis and Gary B. Lamont, Second Edition, McGraw-Hill International, 2002.
6. Digital Control Engineering ,Analysis and Design ,2nd Edition by M. Sami Fadali, Antonio Visioli, Elsevier Publication, ISBN 978-0-12-394391-0

506105- C- Robotics

Teaching scheme: Lectures: 5 Hrs/ Week

Examination Scheme: Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Credits : 5

Elective- I

Module- I

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.

Module- II

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

Module- III

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, modeling and control of a single joint, Present industrial robot control systems and introduction to force control

Module- IV

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

Module- V

Dynamics: - Introduction to Dynamics , Trajectory generations , Manipulator Mechanism Design Machine Vision System: - Vision System Devices, Image acquisition, Masking, Sampling and quantization, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation

Module- VI

Artificial Intelligence: - Introduction to Artificial Intelligence, AI techniques, Need and application of AI

References:

1. John J. Craig, " Introduction to Robotics (Mechanics and Control)", Addison-Wesley, 2nd Edition, 2004
2. K.S. Fu, R.C. Gonzales, C.S.G. Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987.
3. Mikell P. Groover et. al., "Industrial Robotics: Technology, Programming and Applications", McGraw – Hill International.
4. Shimon Y. Nof, "Handbook of Industrial Robotics ", John Wiley Co, 2001.
5. Richard D. Klafter, Thomas A. Chemielewski, Michael Negin, "Robotic Engineering: An Integrated Approach", Prentice Hall India, 2002.

506105- D- Advanced Power Electronics

Teaching scheme: **Examination Scheme:** **Credits** : 5

Lectures: 5 Hrs/ Week Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Elective- I

Module- I

Modern Rectifiers and Converters : Single phase series converters, 12 pulse converters Three phase IGBT based PWM rectifier, analysis, comparison with SCR based conventional converters with respect to harmonic content, P.F. Power factor conditioning of diode rectifiers EMI and Line Power quality problems of thyristor converters Double sided PWM converter systems

Module- II

Application of Motor control: Industrial drive:

AC Motor control: Speed control method of induction motor closed loop control, voltage fed inverter control the controlled-slip system slip power recovery system, VFD, braking of induction motor. Three phase reversible flux vector control for induction motor drive, Direct and indirect vector control; Sensor less vector control, Direct torque and flux control, Adaptive control, cyclo converter based induction motor drive.

DC Motor control : Single-phase SCR drive, Three-phase SCR drive, power factor in SCR motor devices, reversible SCR drives, PLL control of DC drives, Microcontroller based Dc Motor drives. Starting and dynamic braking of separately excited dc motor, closed loop control system, chopper controlled dc drives.

Module- III

Multilevel Inverters: Concept, types, Diode clamped, Flying Capacitor and Cascade Multilevel inverters, Advanced modulation techniques, Trapezoidal, staircase, stepped, harmonic injection and delta modulation. Variable DC Link inverters, sliding mode bi-Directional controlled boost inverters. Space Vector Modulation, Introduction of Z Source Inverters

Module- IV

Resonant converters and Power supplies: Concept of Soft switching, Resonant converter Analysis and Design. SLR, PLR, ZCS, ZVS Converter analysis and Design. Synchronous rectifiers, Low Dropout Regulators, Hot Swappable Redundant Power Supplies, Design of High Frequency magnetic components for converters, Bi-Directional Power Supplies

Module- V

Renewable Energy Sources: Role of Power Electronics in renewable energy, variable wind energy conversion system with DC to Dc converters followed by 3Phase VSI, Photovoltaic energy conversion system, Solar Battery powered drives, traction drives, energy conversion in electrical drives, Battery Chargers.

Module- VI

Power Conditioning: Power quality, power line disturbances and its remedies, energy audit, solar power conditioning, Power transmission. FACTS Flexible AC Transmission, HVDC

References:

1. Power Electronics by M. H. Rashid, 2nd Edition, PHI.
2. Power Electronics by P. C. Sen, TMH.
3. An Introduction to Thyristors and Their Applications by M. Rammurthi (TMH).
4. Electronics in Industry by Chute and Chute.
5. Thyristor Phase control Converters and Cycloconverters by B. R. Pelly.
6. Power Supplies by B. S. Sonde.
7. Power Electronics by Dev.
8. Variable speed drives (ISA).

506106- Lab Practice- I

Teaching scheme:	**Examination Scheme:**	**Credits** : 4
Lectures: 4 Hrs/ Week	Oral: 50 Marks	
	Term- Work: 50 Marks	

Lab practice should be based on the course work. The number of hours is fairly distributed among the number courses, for which the practical work is necessary. The objective of the lab practice is to develop analytical skill and problem tackling skills. Also it is expected that the students must learn to use the latest Instrumentation tools, so that the Industry will get trained Engineers.

SEMESTER- II

506107- Advanced Process Control

Teaching scheme: Lectures: 4 Hrs/ Week

Examination Scheme: Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Credits : 4

Module- I

Introduction: Review of basics of Process Control, Control objective and benefits, Control system elements.

Mathematical Modeling and dynamic performance analysis: Basic Concepts in Modeling, models from fundamental laws, empirical model identification, and dynamic performance analysis of first order, second order, multi-capacity processes, Effect of Zeros and time delay.

Module- II

Advanced Process control: Cascade control, inferential control, override control, selective control, and Design of Multivariable controllers.

Module- III

Adaptive Control: Introduction -Deterministic Self Tuning Regulator: Indirect and Direct self tuning regulator-Model reference Adaptive system: Design of MRAS using Lyapnov and MIT Rule- Auto tuning and Gain scheduling adaptive control design with examples.

Module- IV

Model Based control: Feed Forward Control, Ratio control, Feedback-feed forward, Time-delay compensation, Internal Model controller (IMC): Concept, IMC design, IMC based PID.

Module- V

Model Predictive Control: General Principles, Model forms, DMC, SISO unconstrained DMC Problem, controller tuning.

Module- VI

Process Monitoring: Statistical Process Control-control charts and its interpretation, multivariate charts and controller performance monitoring.

References:

1. Thomas E. Marlin 'Process Control', (McGraw-Hill International 2nd Edition)
2. Jose A. Romagnoli, Ahmet Palazoglu, 'Introduction to process Control' (CRC Taylor and Francis group)
3. B. Wayne Bequette,'Process Control', (Printice Hall of India Pvt. Ltd)
4. B.G. Liptak, 'Handbook of Instrumentation- Process Control'
5. D. Seborg, T.F.Edgar, D.A.Mellichamp,'Process Dynamics and Control' (2nd Edition WILEY INDIA).
6. J. Nagrath, M.Gopal,'Control System Engineering', (New Age Publication 3 rd Edition).

506108- Embedded System Design

Teaching scheme: **Examination Scheme:** **Credits** : 4

Lectures: 4 Hrs/ Week Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Module- I

AVR Microcontroller: Architecture, memory organization, addressing modes, instruction set, programming techniques, assembly language and C programming, development tools, cross compilers, hardware design issues.AVR Peripherals: I/O Memory, EEPROM, I/O ports, SRAM, timer, UART, interrupt structure, ADC/DAC interfacing.

Module- II

ARM Microcontroller: Arcon RISC machine, architectural inheritance, core and architectures, registers, pipeline, interrupts, ARM organization, ARM processor family, co-processors, instruction set, thumb instruction set, instruction set timings, the ARM programmer's model, ARM development tools, ARM assembly language programming and C compiler programming.

Module- III

Embedded Communication Protocols: Embedded networking introduction, Serial/Parallel communication, serial communication protocols, RS-232 standard, RS485 synchronous serial protocols, serial peripheral interface (SPI), inter integrated circuits (I2C), PC parallel port programming, ISA/PCI bus protocols, firmware.

Module- IV

USB and CAN Bus: USB Bus: Introduction, speed identification on the bus, USB states, USB bus communication, packets, data flow types, enumeration, descriptors. CAN bus: Introduction, frames, bit stuffing, types of errors, nominal bit timing.

Module- V

Introduction to Reconfigurable Computing, FPGA Architectures FPGA Design Cycle, Technology-independent optimisation, 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).

References:

1. Steve kilts , "Advanced FPGA Design- Architecture, Implementation and Optimization", John Willey and Sons, 2007
2. Scott hauck and Andre Dehon "Reconfigurable computing: Theory and Practice of FPGA based computing", Elsevier, 2008
3. Maya V. Gokhale and Paul S. Grahmn , "Reconfigurable Computing: Accelerating Computations with FPGA", Springer, 2005
4. Dhananjay V. Gadre „Programming and Customizing the AVR microcontroller,McGrawHill 2001
5. Steve Furber, „ARM system on chip architecture, Addison Wesley, 2000.
6. Andrew N. Sloss, Dominic Symes, Chris Wright, John Rayfield „ARM System Developers Guide Designing and Optimizing System Software, Elsevier 2007.
7. Jan Axelson, „Parallel Port Complete:Programming,interfacing and using the PCs parallel printer port „ , Penram publications, 1996.

506109- Advanced Control System

Teaching scheme:	**Examination Scheme:**	**Credits** : 4
Lectures: 4 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Module- I

Non-linear system analysis: Non-linear system behavior, Jump Resonance, existence of limit cycle, singular points, Concept of phase plane method, Different types of phase portraits, Application of phase plane method to linear and nonlinear control systems, constructing phase portraits.

Module- II

Describing function analysis: Fundamentals, assumptions, definitions. Describing functions of common non-linearities. Describing function analysis of non-linear system. Stability of limit cycles, reliability of describing function analysis.

Module- III

Lyapunov stability: Stability in the sense of Lyapunov, Asymptotic stability, Asymptotic stability in the large, Instability, Quadratic form, Lyapunov second method, Lyapunov stability theorem, Stability analysis of linear and nonlinear systems, Construction of Lyapunov function for nonlinear system by Krasovskii's method, Direct method of Lyapunov and linear system.

Module- IV

Feedback Linearization: Intuitive concepts: Feedback linearization and canonical form; Input-state; Input-output linearization, Mathematical tools, Input-state linearization of SISO systems; Generating a linear input-output relation. Normal forms, The zero-dynamics. Stabilization and tracking; Inverse dynamics and Nonminimum phase systems.

Module- V

Introduction to Sliding Mode Control : Introduction to variable structure system, The basic principle of sliding mode control theory, sliding surface, Reachability, Reaching law, Equivalent control law, discontinuous control law, Chattering, Chattering avoidance/reduction , merits and drawbacks of sliding mode control, Implementations of sliding mode control.

References:

1. J. E. Slotine and w. Li, Applied Nonlinear Control., Prentice Hall Inc. Englewood cliffs, New Jersey 1995.
2. M. Vidyasagar, Nonlinear System Analysis, Prentice-Hall Inc. Englewood cliffs, New Jersey 1978.
3. Gelb A. and Vander Velde W. E., Multiple Input describing Function and Nonlinear System Design, Machrao-Hill (1968).
4. I. J. Nagrath, M. Gopal, Control System Engineering, New Age International Publication, Fifth Edition.
5. Gibson, Nonlinear Automatic Control, Tata Ma-Graw Hill, 1963.
6. V. Utkin, J. Guldner and J. Shi, Sliding Mode Control in Electromechanical Systems, Taylor and Francis, 1999

506110- A- Batch Process Control

Teaching scheme:	**Examination Scheme:**	**Credits** : 5
Lectures: 5 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Elective- II

Module- I

Introduction to Batch Control System , Batch Process Classification, Batch Models

Module- II

Batch Standard, Definition of Batch Terms, Process industry reference model, Characteristics of Batch Process, Equipments for Batch Automation.

Module- III

Control Structure for Batch System, International Standard and practices such as S 88,S 95,USA FDA regulation 21 CFR 11,etc,Recipe Management, Batch control design .system hardware & software

Module- IV

Batch Process requirement, Batch endpoint control, Selections of Controller for Batch Process. Batch Control function, Safety Interlocking, Reliablity & Availability of Batch Control system.

Module- V

Batch Reactor: Temperature Control, Auxiliary Cooling, manipulating feed & product rates, Batch Distillation: Constant distillate rate, constant composition control, Maximizing product recovery. Batch drying: Rate of drying, Heat recovery.

References:

1. Bella G Liptak, 'Instrument Engineer' Handbook, Vol '3', 3rd edition, (CRC Press) (2002).
2. F.G.Shinskey 'Process Control System', 3rd edition,(McGraw-Hill International Edition)
3. T.G.Fisher "Batch Control System",ISA Series,2nd edition,2010

506110- B- Soft Computing

Teaching scheme: Lectures: 5 Hrs/ Week

Examination Scheme: Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Credits : 5

Elective- II

Module- I

Introduction to Fuzzy Logic: Fuzzy Controllers: Preliminaries – Fuzzy sets and Basic notions – Fuzzy relation calculations – Fuzzy members – Indices of Fuzziness – comparison of Fuzzy quantities – Methods of determination of membership functions.

Module- II

Fuzzy Logic Based Control: Fuzzy Controllers: Preliminaries – Fuzzy sets in commercial products – basic construction of fuzzy controller – Analysis of static properties of fuzzy controller – Analysis of dynamic properties of fuzzy controller – simulation studies –case studies.

Module- III

Introduction to Neural Networks: Artificial Neural Networks: Basic properties of Neurons, Neuron Models, Feedforward networks – Perceptrons, widrow-Hoff LMS algorithm; Multilayer networks – Exact and approximate representation, Back propagation algorithm, variants of Back propagation, Unsupervised and Reinforcement learning; Symmetric Hopfield networks and Associative memory; Competitive learning and self organizing networks, Hybrid Learning; Computational complexity of ANNs.

Module- IV

Neural Networks Based Control: ANN based control: Introduction: Representation and identification, modelling the plant, control structures – supervised control, Model reference control, Internal model control, Predictive control.

Module- V

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

References:

1. Bose and Liang, Artificial Neural Networks, Tata Mc graw Hill, 1996.
2. Kosco B, Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence, Prentice Hall of India, New Delhi, 1992.
3. Timothy Ross , “Fuzzy logic with application to engineering systems”, McGraw Hill
4. Klir G.J and Folger T.A, Fuzzy sets, Uncertainty and Information, Prentice Hall of India, New Delhi 1994.
5. Simon Haykin, Neural Networks, ISA, Research Triangle Park, 1995.

506110- C- Modelling and Optimization

Teaching scheme:	**Examination Scheme:**	**Credits** : 5
Lectures: 5 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Elective- II

Module- I

Introduction to Modelling: Introduction to Models, Use of Models, Scope of Models, Types of models, modelling of process control systems in time domain and frequency domain, General modelling principles, first and second order models, higher order models, modelling of first and second order electrical systems, mechanical systems, Degree of freedom Analysis.

Module- II

Dynamic Models of Representative Processes: Reaction dynamics, Balance equations, modelling of Two tanks in series and in parallel, CSTR models, Plug flow reactor model, modelling of flash drum, distillation columns, evaporators, dryers, heat exchangers, Batch reactor

Module- III

Process Identification: Identification of physical processes, off-line and on-line identification, Step testing, pulse testing, sine wave testing, ATV identification method, prediction error methods, introduction to numerical algorithm for subspace state space identification, Least square method, Relationships among time, Laplace and frequency domain.

Module- IV

Analysis of multivariable systems: Open loop and close loop characteristics equations, multivariable Nyquist plot, Loci plot, Niederlinski index, Resiliency, Morari Resiliency Index (MRI), interaction relative gain array (Bristol array) inverse nyquist array , robust nests doylt stein criterion, skogestad and morari method .

Module- V

Basic Concepts of Optimization: Scope of Optimization, Development of Models for optimization, Continuity of functions, Convex and Concave functions, Convex Region, Extremum of the objective functions, quadratic approximation.

Module- VI

Optimization of unconstrained functions. Numerical methods for optimizing a function of one variable , scanning and bracketing procedures, Newton, Quasi Newton and secant methods, region elimination method, polynomial approximation methods, Multidimensional problem, evaluation of unidimensional search methods, unconstrained multivariable Optimization, simplex method, direct methods, indirect methods, steepest descent method secant methods.

References:

1. W. L. Luyben, Process, Modeling, Simulation and Control for Chemical Engineersı by McGraw Hill, 1973
2. Thomas Edgar, David Himmelblau, Optimization of Chemical Processesı, Second edition, McGraw Hill, 2001.
3. W. F. Stoecker, Design of Thermal Systems International Education, McGraw hill 1989.
4. J. Malley, Practical Process Instrumentation and Control ı McGraw Hill.
5. Deo Narsingh ,System Simulation with digital Computer ı Prentice Hall India, New Delhi.
6. Singiresu S.Rao,Engineering Optimization (Therory & Practice),third Edition,New Age International(p) Ltd, Publishers.
7. Dale E. Seborg, T. F. Edgar and D. A. Mellichamp, Process Dynamics and Control, John Willey and Sons publication.

506110- D- Computerized Process Control

Teaching scheme: **Examination Scheme:** **Credits** : 5

Lectures: 5 Hrs/ Week Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Elective- II

Module- I

1. Introduction to Process Control: Incentives for process control, Design aspect of process control systems, Process dynamics and mathematical models, Types of dynamic processes.

Module- II

2. Computers in Process Control: Advantages, Implementation problems: Sampling, Quantization, Aspects of control theory: Transfer function approach, State space approach.

Module- III

3.Computer Oriented Mathematical Models: Discrete-time Systems: Mathematical representation of sampling process, Sampling of Continuous-time state space systems, transformation of state space models, Input-output models, Pulse transfer function and data holds, Development of pulse transfer function of the zero and first order holds, Sampling frequency consideration and selection of optimum sampling period.

Module- IV

4. Closed Loop Response and Stability of Sampled Data Systems: Determination of closed loop transient response, Shur-Cohen-Jury Stability criterion.

Module- V

5. Digital Controllers for Process Control Applications: A brief review of three term controller and their realization, Implementation aspects: Refinement of three term algorithms, other Controller enhancement: linearization, Adaption, Sample rate selection, Consideration of computational accuracy.

Module- VI

6. Design of Digital Controllers: Digital approximation of classical controllers, Effect of sampling, Different class of digital controllers, Ringing and placement of poles, Design of optimal regulatory control systems. Control of Time Delay Systems: Simulation of pure time delay systems, Smith's principle and method.

References:

1. P. B. Deshpande and R. H. Ash, Computer Process Control with advanced control applications, Second Edition, Instrument Society of America Publication, 1988.
2. R. Isermann, Digital Control Systems, Vol.I: Fundamentals, Deterministic Control, Springer-Verlag Publications.
3. K. Warwick and D. Rees, Editors: Industrial Digital Control Systems, IEE Control Engineering Series, UK, 1986.
4. J. R. Leigh, Applied Digital Control, Theory, Design and Implementation, Prentice-Hall International, 1985.
5. G. Stephanopoulos, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall of India, 1998.
6. K. J. Astrom and B. Wittenmark, Computer Controlled Systems: Theory and Design.

506111- Lab Practice- II

Teaching scheme: **Examination Scheme:** **Credits** : 4

Lectures: 4 Hrs/ Week Oral: 50 Marks

Term- Work: 50 Marks

Lab practice should be based on the course work. The number of hours is fairly distributed among the number courses, for which the practical work is necessary. The objective of the lab practice is to develop analytical skill and problem tackling skills. Also it is expected that the students must learn to use the latest Instrumentation tools, so that the Industry will get trained Engineers.

506112- Seminar- I

Teaching scheme: **Examination Scheme:** **Credits** : 4

Lectures: 4 Hrs/ Week Oral: 50 Marks

Term- Work: 50 Marks

Seminar -I Shall be on state of the art topic of student's own choice approved by an authority. The student shall submit the duly certified seminar report in standard format using LATEX, for satisfactory completion of the work by the concerned Guide and head of the department/institute.

SEMESTER- III

606101- Advanced Signal Processing

Teaching scheme:	**Examination Scheme:**	**Credits** : 4
Lectures: 4 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Module- I

Fundamentals of DSP background and review discrete time random signals. Time frequency analysis, the need for time frequency analysis, Time frequency distribution, FFT, Short time Fourier Transform.

Module- II

Adaptive filtering : Principles of Adaptive filtering , LMS and RMS Algorithms, Applications in noise and echo cancellation, Homomorphic Signal Processing , homomorphic system for convolution, properties of complex-spectrum, Applications of homomorphic deconvolution.

Module- III

Multirate digital signal processing: Fundamentals of Multirate systems, Basic multirate operations, Decimation, interpolation, filter design and implementation of sampling rate conversion, polyphase filter structures, time variant filter, structures, multistage implementation of sampling rate conversion of BP signals, sampling rate conversion by an arbitrary factor, interconnection of building blocks, polyphase representation, multistage implementations.

Module- IV

Wavelet Transform: Introduction to wavelets, wavelets and wavelet expansion systems, discrete wavelet transform, multiresolution formulation of wavelet systems, Haar Wavelet and other wavelet representations, scaling function, wavelet functions, Parseval's theorem.

Module- V

Multirate filter banks: Maximally decimated filter banks, errors created in QMF banks, simple alias free QMF system, power symmetric filter banks, M channel filter banks, polyphase representation, PR systems, alias free filter banks, Linear phase PR QMF banks, cosine modulated filter banks, Wavelet transform and its relation to multirate filter banks, paraunitary PR filter banks, Applications of multirate signals processing narrowband LPF, subband coding of speech.

Module- VI

Linear Prediction: Innovations representation of a stationary random process, forward and backward linear prediction, solutions of the normal equations (Levinson-Durbin algorithm and Schur algorithm)

Power Spectrum Estimation: Parametric and non-parametric methods for power spectrum estimation

References:

1. J. Proakis , Charles M. Rader, Fuyun Ling, Christopher L. Nikias, *'Advanced Digital Signal Processing*', (Macmillan Coll Div) (1992)
2. Glenn Zelniker, Fred J. Taylor, *'Advanced Digital Signal Processing*', (CRC Press) (1994)M. Gopal, Modern Control System Theory, Second Edition, New Age International (P) Limited, New Delhi, 1996.
3. Leon Cohen, *"Time Frequency Analysis"*, (Prentice Hall), (1995).
4. Haykins, *"Adaptive Filter theory",* (Prentice Hall) (1986)
5. P. P. Vaidyanathan, "*Multirate filters and Filter banks"* PH International, Englewood Cliffs
6. Rabiner and Schafer "*Multirate signal Processing*" PH Inernational, Englewood Cliffs
7. C. S. Burrus, Ramesh and A. Gopinath, "*Introduction to Wavelets and Wavelet Transform*" Prentice Hall Inc.
8. J. G. Proakis and D. G. Manolakis *"Digital Signal Processing: Principles, Algorithms, and Applications"*, Prentice Hall of India Ltd, 1995.
9. A.V.Oppenheim and R.W.Schafer, *"Discrete time Signal Processing*", (Prentice Hall)

606102- Building Automation

Teaching scheme:	**Examination Scheme:**	**Credits** : 4
Lectures: 4 Hrs/ Week	Theory: 50 marks (In Semester)	
	Theory: 50 Marks (End Semester)	

Module- I

Fire Security Systems: Basics of Fire, Fire Alarm Systems (Conventional and Intelligent/Addressable FAS), FAS Architectures, FAS standards such as NFPA. Fire suppression systems.

Module- II

Access Security Systems: Basics of Access security systems, Access Control Systems Components such as Cameras, Lenses, Recording devices, storage and Network components and systems, Perimeter Intrusion Detection systems.

Module- III

HVAC Systems: Introduction to HVAC Systems components , Introduction to the Psychrometric Chart, Basic Air-Conditioning System, Zoned Air-Conditioning Systems, System Choice Matrix, Human Comfort, Introduction to Thermal Comfort, Seven Factors Influencing Thermal Comfort, and Conditions for Comfort, Ventilation Process & Applications, Heating Process & Applications, Air Handlers and Unitary Equipment, Hydronic Systems and architecture, Central Plants: Central Plant versus Local Plant in a Building, Heaters, Boilers, Chillers, Cooling Towers.

Module- IV

DDC Networks, Controls, Protocols: Introduction to Direct Digital Control, System Hardware, Architecture and Advantages of DDC Architecture, Network Standards, BACnet, Lon Works, Benefits and Challenges of DDC, Bidding and Interoperability, Energy Conservation Measures.

Module- V

Integrated Building Management System: Green Building Requirements, Energy Efficiency in building, Energy Management: Advantages of BMS, Energy Savings concept & methods, Energy Considerations for Buildings, Lighting control.

Module- VI

Project Lifecycle Management: Meaning, Project Lifecycle – Sales Process, Sales Project Handover, Materials Requirement, Project Funding, Budgeted Cost, PR, PO, Material Lead Time, Engineering, Submittals, and Payment Terms. Role of Architect, Consultant, PE, PM, MM& CM. Installation, testing, Programming, Commissioning, Troubleshooting, Project Handing Over, Project Closure & Signoff. Skills, Required By PE & PM.

References:

1. Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs) by Reinhold A. Carlson (Author), Robert A. Di Giandomenico (Author).
2. Fundamentals of HVAC Control Systems by Ross Montgomery, Robert McDowall Inc.1791 Tullie Circle NE, Atlanta, GA 30329, USA.
3. HVAC control System design Diagrams, John I Levenhagen, Mc-Graw-Hill Publications.
4. HVAC Controls and Systems, I Levenhagen, Donald H Spethman McGraw-Hill Publications

606103- A- Environmental Studies

Teaching scheme: **Examination Scheme:** **Credits** : 5

Lectures: 5 Hrs/ Week Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Elective- III

Module- I

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance Need for public awareness.

Module- II

Natural Resources

Renewable and Non-renewable Resources: Natural resources and associated problems.

(a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

(b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

(d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, Case studies.

(e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

(f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Module- III

Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem:

(a) Forest ecosystem

(b) Grassland ecosystem

(c) Desert ecosystem

(d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module- IV

Biodiversity and Its Conservation

Introduction, definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Module- V

Environmental Pollution

Definition Causes, effects and control measures of

(a) Air pollution (b) Water pollution

(c) Soil pollution (d) Marine pollution

(e) Noise pollution (f) Thermal pollution
(g) Nuclear hazards
Solid waste management: Causes, effects and control measures of urban and industrial Wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: Foods, earthquake, cyclone and landslides.

Module- VI

Social Issues and the Environment

From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness.

References:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad –380 013,
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill
4. Clark R.S., Marine Pollution, Clanderson Press Oxford
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment
8. Gleick, H.P. 1993. Water in Crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press
9. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay
10. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi
12. Mckinney, M.L. & School, R.M. 1996. Environmental Science Systems & Solutions, Web enhanced edition

606103- B- Pollution Control

Teaching scheme: **Examination Scheme:** **Credits** : 5

Lectures: 5 Hrs/ Week Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Elective- III

Module- I

Parameters influencing air pollution, measurement of parameters

Plume behaviour, transport, and diffusion. Formulae for stack heights, Gaussian diffusion models for finding ground level concentration.

Module- II

Design problems of height of chimney and ground level concentration.

Air Pollution survey, Basic and statistical considerations of sampling sites, Devices and methods used for sampling gases and particulars, Stack sampling, Iso kinetic sampling Analysis of air samples, Chemical and instrumental methods,

Ambient air quality standards and emission standards Photochemistry of air pollution, Photochemical smog reactions involved in its formation

Module- III

Factors influencing its reactions. Effects on man, animals, vegetation and property, Economics of loss due to pollution, Episodes, Air Pollution index.

Odors: Sources, measurement and control.

Control of Pollution: By process modification, Change of raw materials, Fuels, process equipment and process operation by use of air pollution control equipments, For particulate pollutants, Air Pollution control by using Equipments, Design of control equipments as ESP, Scrubber, Bag filter, Cyclones etc

Module- IV

Control of gaseous pollutants Absorption devices, Adsorption Devices, Combustion devices, Condensation devices. Air Pollution Control by Legislation and regulation: The Environment (Protection) act, 1986, Emission standards for Stationary sources and mobile sources.

Module- V

Economics of air pollution control: Cost / benefit ratio, optimization

Environmental Impact Assessment: Definition, Broad Goals, Objectives, Phases in EIA, Contents of Application form, Advantages & Disadvantages of EIA, Environmental management plan, Environmental Impact of Industries, Urbanization and Agricultural activities.

Module- VI

Vehicular Pollution Sources of pollution, Characteristics of exhaust gases, Traffic problem in major Cities, Control Techniques. Fuel Modification, Bio Diesel, Ethanol, Modifications in Engine Design, Catalytic Converter, Euro Standards

Noise Pollution Sources. Noise characteristics, measurement of noise, Effects of noise, Control of noise. Wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: Foods, earthquake, cyclone and landslides.

References:

1. Air Pollution: Supplement to Measurements, Monitoring Surveillance and Engineering Control Vol.7 Academic Press Inc., Orlando 3rd Edn.
2. Pollution Control Handbook, 1986 P. L. Diwakar Rao Utility Publications
3. Introduction to Environmental Engineering, MacKenzie Leo Davis, David A. Cornwell
4. Environmental Pollution Control Engineering, C S Rao, New Age International

606103- C- Fundamentals of Disaster Management

Teaching scheme: **Examination Scheme:** **Credits** : 5

Lectures: 5 Hrs/ Week Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Elective- III

Module- I

Introduction: Definition and Concept of Hazard, Risk, Vulnerability and Disaster, Types and classification of Disasters

Module- II

Nature Induced Disasters:

Earthquakes, Floods and Cyclones. Avalanches, Forest Fire and Tsunami.

Module- III

Human Induced Disasters:

Nuclear, Chemical and Industrial Disasters, Global warming; Biological Disasters; Epidemics

Module- IV

Disaster Management: Meaning, Concepts, Approaches, Principles, Objectives and Scope

Essentials of Disaster Management; Institutional and Individual's responsibilities during risk reduction, preparedness, response and recovery phases

Module- V

Regional Profile of India based on Earthquakes, Droughts, Floods and Cyclones.

Module- VI

Disaster Management Frame in India National Level, including National Disaster management Authority. State Authorities, Local Groups and Committees

References:

1. Disaster Management By G.K. Ghosh A.P.H. Publishing Corporation
2. Disaster Management By R.B. Singh Rawat Publications
3. Disaster Management - Recent Approaches By Arvind Kumar Anmol Publications
4. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
5. Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.

606103- D- Constitution of India

Teaching scheme: **Examination Scheme:** **Credits** : 5

Lectures: 5 Hrs/ Week Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Elective- III

Module- I

Framing of the Indian Constitution: Role of the Constituent Assembly – the Preamble,
Fundamental Rights and Duties – Directive Principles, Nature of Indian Federalism: Union-State Relations.

Module- II

Union Executive: President, Vice-President: election, position, functions (with reference to Emergency Powers), Prime Minister, Council of Ministers, relationship of Prime Minister and President, Union Legislature: Rajya Sabha, Lok Sabha: Organisation, Functions – Law-making procedure, Privileges, Committee system – Speaker.

Module- III

Government in the states: Governor, Chief Minister and Council of Ministers: position and functions – State Legislature: composition and functions, The Judiciary: Supreme Court and the High Courts: composition and functions – Judicial activism.

Module- IV

Constitutional amendment: Procedure – main recommendations of the Constitutional Review Commission (Venkatachalliah Commission), Party system: features and trends – major national political parties in India: ideologies and programmes – coalition politics in India: nature and trends – political parties in West Bengal: An overview.

Module- V

Electoral process: Election Commission: composition, functions, role, Role of business, working class, peasants in Indian politics.

Module- VI

Role of (a) religion (b) language (c) caste (d) tribe and (e) regionalism in Indian politics,
New Social Movements since the 1970s: (a) environmental movements, (b) women's movements, (c) human rights movements.

References:

1. Introduction to the Constitution of India 20 Edition, Authored , Durga Das Basu Lexisnexis Publications (2012)
2. Kagzi, M.C. Jain The Constitutional of India Vol.1 & 2. -New Delhi: India Law House, 2001.
3. Ramana, M.V.V. Inter-State River Water Disputes in India -New Delhi: Orient Longman, 1992
4. Pylee, M.V. Constitutional Amendments in India -Delhi: Universal Law,2003.
5. Datar, Arvind P. Datar on Constitution of India -Agra : Wadhwa & Co.,2001

606104- Seminar- II

Teaching scheme: **Examination Scheme:** **Credits** : 4

Lectures: 4 Hrs/ Week Oral: 50 Marks

Term- Work: 50 Marks

Seminar II : shall be on the topic relevant to latest trends in the field of concerned branch,
Preferably on the topic of specialization based on the electives selected by him/her approved by authority. The student shall submit the seminar report in standard format using LATEX, duly certified for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

606105- Project Stage- I

Teaching scheme: **Examination Scheme:** **Credits** : 08

Lectures: 8 Hrs/ Week Oral: 50 Marks

Term- Work: 50 Marks

PROJECT WORK:
The project work shall be based on the knowledge acquired by the student during the coursework and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

Project work Stage – I is an integral part of the project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature Review, project overview, scheme of implementation mathematical model/SRS/UML/ERD/block diagram/ PERT chart, etc.) and Layout & Design of the Set-up. As a part of the progress report of Project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected dissertation topic. The student shall submit the duly certified progress report of Project work Stage-I in Standard format using LATEX for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

Note: As per University examination rule R 1.5, a student will become eligible to register for Project Work Stage ll only after he/she secures passing grade in Project Work Stage I.

SEMESTER- IV

606106- Seminar- III

Teaching scheme: | **Examination Scheme:** | **Credits** : 05

Lectures: 05 Hrs/ Week

Oral: 50 Marks

Term- Work: 50 Marks

Seminar III: shall preferably an extension of seminar II. The student shall submit the duly certified seminar report in standard format using LATEX, for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

606107- Project Stage- II

Teaching scheme: | **Examination Scheme:** | **Credits** : 20

Lectures: 20 Hrs/ Week

Oral: 50 Marks

Term- Work: 150 Marks

In Project Work Stage – II, the student shall complete the remaining part of the project which will consist of the fabrication of set up required for the project, work station, conducting experiments and taking results, analysis & validation of results and conclusions. The student shall prepare the duly certified final report of project work in standard format using LATEX for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

NOTE: For more details Refer University of Pune Rules and Regulations for M.E. Programme under Faculty of Engineering effective from June 2013(Available on www.unipune.ac.in)