University of Pune

Structure for M. E. Instrumentation and Control - Biomedical 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
506202	Bio- Signal Processing	4	50	50	-	-	100	4
506203	Analytical Instrumentation	4	50	50	-	-	100	4
506104	*Research Methodology	4	50	50	-	-	100	4
506205	Elective I	5	50	50	-	-	100	5
506206	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				
506207	Transducer Design	4	50	50	-	-	100	4
506208	Digital Image Processing	4	50	50	-	-	100	4
506209	Communication Protocols for Instrumentation	4	50	50	-	-	100	4
506210	Elective II	5	50	50	-	-	100	5
506211	Lab Practice II	4			50	50	100	4
506212	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				
606201	Medical Imaging Techniques	4	50	50	-	-	100	4
606202	Advanced Digital Signal Processing	4	50	50	-	-	100	4
606103	Elective III	5	50	50	-	-	100	5
606204	Seminar II	4	-	-	50	50	100	4
606205	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	
606206	Seminar III	5	-	50	50	100	5
606207	Project Work Stage II	20	-	150	50	200	20
Total		25	-	200	100	300	25

List of the Electives:

Sr. No.	Elective-I	Elective-II	Elective-III
A	Fundamentals of Biomedical Instrumentation	Control System Design	Environmental Studies
B	Introduction to Physiology and Anatomy	Rehabilitation Engineering	Pollution Control
C	Physiological Modelling	Bio-MEMS	Fundamentals of Disaster Management
D	Bio- Photonics	Wavelets for Bio-signal Processing	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

506202- Bio- Signal Processing

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

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

Theory: 50 Marks (End Semester)

Module- I

Introduction: Basic elements of DSP, Comparison between DSP and Analog Signal Processing, applications of DSP.

Discrete Time Signals and Systems: classification of signals-continuous and discrete time signals, periodic and a periodic signals, even and odd signals, energy and power signals, operations on sequences- shifting, folding, addition, multiplication, scaling, etc. classification of systems- linear vs. nonlinear ,time variant vs. time invariant, causal vs. noncausal , stable vs. unstable system, impulse response, convolution, sampling process, aliasing, antialiasing filter, reconstruction, correlation, autocorrelation, cross correlation,

Module- II

Analysis of Discrete time LTI systems ,Discrete time systems described by difference equations, Implementations of Discrete time systems

Module- III

Transform domain techniques: Z-transform, Region of convergence(ROC), Z-transform properties, Discrete time Fourier Transform, Discrete Fourier Transform (DFT), DFT properties, Inverse DFT, FFT algorithms.

Module- IV

Basics of Digital Filtering: Digital filter, types of digital filters, transfer function, Z-plane pole-zero plot.

FIR Filters: characteristics of FIR filters, smoothing filters, Hanning filter, Notch filter, Window design technique, frequency sampling method, derivative filters, removal of noise, motion artifacts from ECG signal, removal of baseline drift in ECG using different FIR filters

Module- V

IIR Filters: General equation of IIR filters, integrators, Mapping between S-plane and Z-plane. Bilinear transformation method, removal of high frequency noise and periodic events using different IIR filters.

Module- VI

Integer filters: basic design concept, low-pass and high-pass filters, band pass and band reject filters, biomedical applications.

Adaptive Filters: basic concept, principal noise cancellation model, removal of periodic events using adaptive cancellation, adaptive cancellation of maternal ECG from Fetal ECG of interest.

References:

1. Willis J. Tompkins, '*Biomedical Digital Signal Processing',* (Prentice Hall of India Pvt. Ltd. New Delhi) (1993)
2. Oppenheim & schafer, *'Digital signal processing'* (Prentice Hall)
3. Sanjit K Mitra, *'Digital signal processing'* (Tata Mcgraw-hill Publishing company ltd.)
4. J. G. Proakis , D.G. Manolakis, *'Digital Signal Processing*',(PHI)

506203- Analytical Instrumentation

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

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

Theory: 50 Marks (End Semester)

Module- I

Introduction: Introduction to chemical analysis, Classical and Instrumental methods, Classification of Instrumental techniques, important considerations in evaluating an instrumental method.

Module- II

Absorption methods:

a. Spectrometric UV and VIS methods: Laws of photometry, Instrumentation.
b. IR spectrometry: correlation of IR spectra with molecular structure, Instrumentation.
c. Atomic absorption spectrometry: Principle, Instrumentation

Module- III

Emission methods: Flame, AC/DC arc, spark, plasma excitation sources, instrumentation Spectrofluroscence and phosphorescence spectrometer: Instrumentation, Raman spectrometer

Module- IV

Mass spectrometer: Ionisation methods, mass analysers, mass detectors, FTMS.
Chromatography: Classification, Gas chromatography, Liquid chromatography, Instrumentation

Module- V

X-ray and Nuclear methods: x-ray absorption, fluorescence and diffractometric techniques, electron microscope and microprobe, ESCA and Auger techniques, nuclear radiation detectors.

Module- VI

NMR spectroscopy: Principle, chemical shift, spin-spin coupling, instrumentation, types of NMR.
Electroanalytical methods: potentiometry, voltammetry, coulometry techniques.

References:

1. Willard, Merritt, Dean and Settle, *Instrumental Methods of Analysis*, 7th edition, (CBS publishers, New Delhi).
2. Galen W. Ewing, *Instrumental Methods of Chemical Analysis*, 5th edition, (McGraw-Hill Book Company)

506104- Research Methodology

Teaching scheme: Lectures: 4 Hrs/ Week

Examination Scheme: Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Credits : 4

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

506205- A- Fundamentals of Bio- Medical Instrumentation

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

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

Theory: 50 Marks (End Semester)

Elective- I

Module- I

Biotransducers:

Transduction Principles**:** Resistive Transducers Strain Gauge- types, construction, selection materials, Gauge factor, Bridge circuit, Temperature compensation. Strain Gauge type Blood pressure transducers. Thermo resistive transducer, Inductive Transducers, Capacitive Transducer Piezoelectric Transducer Bio potential Measurement.

Module- II

Cell Structure: Basic Cell Functions, Origin of Biopotentials, Electrical Activity of Cells, Electrode-Electrolyte interface, half cell potential, Polarization- polarizable and non-polarizable electrodes, Ag/AgCl electrodes, Electrode circuit model; Electrode and Skin interface and motion artifact. Body Surface recording electrodes for ECG, EMG, EEG. Electrodes standards.

Module- III

Biomedical Instrumentation Cardiac Measurement: Cardiovascular System, Heart Structure, Cardiac Cycle, ECG Theory, ECG Electrodes, Electrocardiograph, Indicator dilution methods; Measurement of continuous Cardiac output derived from aortic pressure waveforms, cardiac Arrhythmias; Phonocardiogram.

Module- IV

Blood pressure measurement techniques, Foetal heart rate measurements Plethysmography. Cardiac Pacemakars, Defibrillators, Heart- Lung Machine (HLM) Patient monitoring systems: Different Types of ECG Monitors, Ambulatory monitoring Instruments. Measurement of heart rate, Blood pressure, Temperature, Respiration rate, Apnea detectors; Computerized patient monitoring system. Pulmonary Function Analyzers, Ventilators Blood Flow meters

Module- V

Cell Counters : Methods of Cell counting- Coulter Counters; Automatic recognition and differential counting of cells; Auto analyzer. Nervous System, Myoelectric voltages, Electromyography

Module- VI

Electrical safety:- Significance of Electrical Danger, Physiological Effect of Current, Ground Shock Hazards, Methods of Accident Prevention Kidney Instrumentation, Sensory Instrumentation, Evoked response Audiometer system, Hearing Aids Anatomy of Eye, Errors in Vision, ophthalmoscope, Tonometer, Perimeter.

References:

1. Harry.N. Norton, '*Biomedical Sensors- Fundamentals and applications*'(William Andrew Publications) (1982)
2. Richard S.C. Cobbold, '*Transducers for Biomedical measurements*' (Krieger Publishing Company) (1974).
3. John G. Webster, '*Medical Instrumentation application and design*' 3 edition (Wiley) (1997).
4. Geddes L.A and Baker L.E, '*Principles of Applied Biomedical Instrumentation'* 3 edition, (Wiley-Interscience) (1989).
5. E.A.H.Hall, '*Biosensors*', (Prentice Hall, Advanced Reference Series, Engineering, New Jersey)(1991).
6. Tatsuo Togawa, Toshiyo Tamura, P. Ake Oberg, *'Biomedical Transducers and Instruments*', (CRC Press) (1997).
7. R.S. Khandpur, '*Handbook of Biomedical Instrumentation',* 2 edition (Tata McGraw Hill New Delhi) (1987).

506205- B- Introduction to Physiology and Anatomy

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

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

Theory: 50 Marks (End Semester)

Elective- I

Module- I

Cell and Tissues: Physical Structure of the Cell, Functional System of the cell-Transport of Ions and Molecules through the cell membrane, Membrane Potentials and Action Potentials, Inhibition ofExcitability; Recording Membrane potentials and Action potentials. Skeletal and Muscular System:Structure and Formation of bone, Types of bones, joints, Classification of movements, Classification of muscles- Muscle contraction mechanism, EMG.

Module- II

Body Fluids: Blood and its composition and function, Various Cells and their structures, Numbers Cell counting, Haemoglobin and its estimation, Anaemia, Blood counts and ESR.

Module- III

Respiratory System: Structure of Respiratory tract, Lungs, Diaphragm, Mechanics of Pulmonary Ventilation, Pulmonary Volumes and Capacities, Physical Principle of Gas Exchange, Pulmonary function testing, Artificial Respiration. Cardiovascular System: Structure of Heart, Heart valves, Arteries, Veins, Coronary Circulation, Heart as a pump, Physiology of Cardiac muscle, Cardiac Cycle, Rhythmic excitation of heart, Control of excitation and conduction in the heart.

Module- IV

Introduction of ECG and cardiac activity: Physics of Blood pressure, flow and resistance, Vascular distensibility and functions of Arterial and Venous Systems, Heart rate and normal Heart sounds. **Nervous System:** Outline of Cranial and Spinal nerves, Structure of Spinal Cord and different Brain parts, Vertibral column and Cranial cavity, Excitation of skeletal muscle- Neuro muscular transmission, Excitation-Contraction Coupling, Contraction of Smooth muscle.

Module- V

General design of Nervous System- CNS- its function, Synapses, Receptors, Types of Sensation. EEG. **Excretory System:** Structure of Kidney, Formation of Urine, Concentration and Dilution of Urine, Renal Function Tests, Artificial Kidneys, Dialysis. Special Senses: Vision: Eye as a camera, Mechanism of accommodation, Visual acuity, Ophthalmoscope, Colour vision, Perimetry.

Module- VI

Hearing: Tympanic membrane and the Ossicular system, the cochlea, Hearing mechanics and abnormality, Deafness, Audiometry. Endocrine System, Physiological actions of the hormones secreted by: Pituitary, Thyroid, Parathyroid, Islets of Langerhans, Adrenal, Testes and Ovaries, Bio feedback mechanism of hormone regulation. Homeostasis- Regulation of Internal Environment.

References:

1. Anne Waugh, Allison, '*Grant Ross and Wilson: Anatomy and Physiology in Health and Illness',*9th edition, (Churchill Livingstone) (2001).
2. Ann B. McNaught and Robin Callander, '*Illustrated Physiology'*, (Williams and Wilkins Company, Baltimore) (1963).
3. Chaurasia B.D., '*Human Anatomy: Regional and Applied*' , 4th edition, (CBS Publishers And Distributors) (2004).
4. Guyton Arthur C., *'Physiology of Human Body'*, (Saunders College Publishing, Inc, Philadelphia, PA, U.S.A.) (1979).
5. Chneck , '*Engineering Principles of Physiological Functions'*.
6. Agar AMR, Lee MJ, *'Grant's Atlas of Anatomy'*, edition 9, (Baltimore, MD, Williams & Wilkins) (1991).
7. A.K.Datta , *'Principles of General Anatomy'*, 5th edition.

506205- C- Physiological Modelling

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

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

Theory: 50 Marks (End Semester)

Elective- I

Module- I

Approaches to modeling - The technique of mathematical modeling, classification of models, characteristics of models. Purpose of physiological modeling and signal, analysis, linearization of nonlinear models, Time invariant and time varying systems for physiological modeling

Module- II

Equivalent circuit model - Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential, the voltage dependent membrane constant and simulation of the model, model for strength-duration curve, model of the whole neuron. Huxley model of isotonic muscle contraction, modeling of EMG, motor unit firing: amplitude measurement, motor unit & frequency analysis.

Module- III

Physiological modeling - Electrical analog of blood vessels, model of systematic blood flow, model of coronary circulation, transfer of solutes between physiological compartments by fluid flow, counter current model of urine formation, model of Henle's loop, and Linearized model of the immune response: Germ, Plasma cell, Antibody, system equation and stability criteria.

References:

1. Endarle, Blanchard & Bronzino, "Introduction to Biomedical Engg." , Academic press, 2001.
2. Suresh.R.Devasahayam, "Signals & Systems in Biomedical Engineering", Kluwer Academic/ Plenum Publishers, 1998.
3. V.Z. Marmarelis, "Advanced methods of physiological modeling", Plenum Press, 2000.
4. J. Candy, "Signal Processing: The Model Based approach", Mc. Graw Hill, 2003.
5. L.Stark, "Neurological Control System", Plenum Press, 2001.
6. R.B. Stein, "Nerve and Muscle", Plenum Press, 1988.

506205- D- Bio- Photonics

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

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

Theory: 50 Marks (End Semester)

Elective- I

Module- I

Laser Physics:

1. Fundamentals of Laser-Generation Physics, Types –solid state, Liquid, semiconductor, Gas, Dye LASER, their wavelength used in medicine, Properties of Lasers.
2. Interaction of Laser with Tissue: Non-Thermal and thermal effects: Photochemical effect, photo mechanical effect, coagulation, evaporation,

Module- II

Medical Applications:

1. Dermatological: Tattoos, port wine, facial toning,
2. Ophthalmic: Diabetic retinopathy, retinal detachment, holes, and tears. Glaucoma treatments.
3. Endoscopy: Role of LASER in Chest Medicine, Fluorescent bronchoscopy, Gastroenterology.
4. Photo radiation Therapy**:-**Treatment for many Malignant disease.
5. Neurosurgery:-Micro vascular Experimental studies etc.

Module- III

Laser Hazards and Safety Aspects: Biological Effects of LASER Radiations, safety exposure limits, ANSI, FDA, FEDERAL STANDERDS, Hazards Classifications, protective measures.

References:

1. John enderle susan Blanchard & Joseph Branzino, *'Introduction To Biomedical Engineering'*, (Academic Press)
2. *Introduction to LASERs*, AICTE-CEP Publication
   JAS Carruth , AL Mc Kenezie, *'Medical LASERS-Science and clinical practice'* (Springer London) (1987)

506206- 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

506207- 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)

506208- Digital Image Processing

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

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

Theory: 50 Marks (End Semester)

Module- I

Introduction to Digital Image Processing:

Digital image representation, fundamental steps in image processing, elements of digital image processing systems, hardware for image processing system, Characteristics of image digitizer, Types of digitizer, Image digitizing components, Electronic image tube cameras, solid state cameras, scanners.

Module- II

Fundamentals of Digital Image Processing:

Elements of visual perception, a simple image model sampling and quantization some basic relationship between pixels, image geometry, Basic transformations, Perspective transformation, Camera model and calibration, stereo imaging.

Module- III

Image Transforms:

2-D Fourier transform, Discrete cosine transform, Short time Fourier transform, Gabor transform, Radon transform.

Module- IV

Image Enhancement:

Enhancement by point processing, spatial filtering, enhancement in the frequency domain. Contrast intensification: linear stretching, non-linear stretching, histogram
specification, low contrast stretching. Smoothing: Image averaging, mean filter, order statistics filter, edge preserving smoothing. Sharpening: High pass filtering, homomorphic filtering. Introduction to color image processing

Module- V

Image Restoration:

Degradation model, diagonalization of circulate and block-circulate matrices, algebraic approach to restoration, inverse filtering, least mean square (wiener) filter, constrained least squared restoration, invractive restoration.

Module- VI

Image Analysis:

Segmentation: detection of discontinuities, edge linking and boundary detection, thresholding, region - oriented segmentation, Representation and description: Representation schemes, descriptors, regional descriptors, pattern and pattern classes, Classifiers.

Edge Detection: derivative operators: Sobel, Prewittt, Canny, second order derivative, line detection.

References:

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson Education Asia, 2002.
2. A. K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India Pvt Ltd, New Delhi, India, 1989.
3. K. R. Castleman, "Digital Image Processing", Prentice-Hall International, 1996.
4. R. C. Gonzalez and R. E. Woods, "Digital Image Processing using Matlab", Pearson Education Asia, 2002.

506209- Communication Protocols in Instrumentation

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

Module- I

An Introduction to Networks in process automation: Information flow requirements, Hierarchical communication model, Data Communication basics, OSI reference model, Industry Network, Recent networks

Module- II

Introduction to Communication Protocols: Communication basics, Network Classification, Device Networks, Control Networks, Enterprise Networking, Network selection.

Module- III

Proprietary and open networks: Network Architectures, Building blocks, Industry open protocols (RS-232C, RS- 422, RS-485), Ethernet, Modbus, Modbus Plus, Data Highway Plus, Advantages and Limitations of Open networks.

Module- IV

Fieldbus: Fieldbus Trends, Hardware selection, Fieldbus design, Installation, Documentation, Fieldbus advantages and limitations.

Foundation Fieldbus & Profibus: Introduction, Design, Calibration, Commissioning, Application in Hazardous and Non-Hazardous area.

Module- V

HART: Introduction, Design, Installation, calibration, commissioning, Application in Hazardous and Non-Hazardous area.

Module- VI

Introduction to wireless Protocols: WPAN, Wi-Fi, Bluetooth, ZigBee, Z-wave.

References:

1. B.G. Liptak, ' *Process Software and Digital Networks*:, (CRC Press ISA- The Instrumentation, Systems, and Automation Society).
2. Romilly Bowden , *'HART Communications Protocol'* , (Fisher-Rosemount).
3. User Manuals of Foundation Fieldbus, Profibus, Modbus, Ethernet, Devicenet, Controlnet.

506210- A- Control System Design

Teaching scheme: Lectures: 5 Hrs/ Week

Examination Scheme: Theory: 50 marks (In Semester)

Theory: 50 Marks (End Semester)

Credits : 5

Elective- II

Module- I

Design concepts in continuous time control systems:

Design of compensators: Lead Compensator, Lag compensator and Lag-Lead compensator using root locus and Bode plot.

Module- II

Controller Design: Direct controller synthesis, Internal model controller design, Decoupler design

Module- III

Design concepts in state space: Pole placement via state variable feedback, State observer theory, design of full order state observer, design of minimum order state observer, design of optimal state regulator.

Module- IV

Design concepts in discrete time control systems:

Design of compensators: Lead Compensator, Lag compensator and Lag-Lead compensator using root locus and Bode plot.

Module- V

Controller Design: Direct controller synthesis, Discretization of continuous controller,

Design concepts in state space: Pole placement via state variable feedback, State observer theory, design of full order state observer, design of minimum order state observer, design of optimal state regulator.

Module- VI

Advances in control system design:

Model predictive controller, Concepts of robust control, H-infinity design technique.

References:

1. Goodwin , Graebe S F & Salgado M E, ' *Control System Design'* , (Prentice hall of India Delhi) (2002).
2. Friedland B., *'Advanced Control System Design'* , (New Jercy. Prentice Hall Inc) (1998).
3. Ogata K., *'Discrete Time Control Systems'* , (Prentice Hall of India, Delhi) (2004).
4. Ogata K., *'Modern Control Engineering'* , (Prentice Hall Of India Pvt. ltd.) (1992).
5. M.Gopal, *'Digital Control and State Variable Method'* , (Tata-McGraw Hill, Delhi) (1997).
6. Contantine H. and Gary B. Lamont, *'Digital Control Systems'* , Second Edition, (McGraw-hill International) (2002).
7. Bequette, B.W. Process Control,Modeling, *'Design and Simulation'* , (Prentice Hall of India) (2004).

506210- B- Rehabilitation Engineering

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 Rehabilitation:

Definition, Concept of Rehabilitation: Orthrosis & Prosthesis, Types of Physical Impairments, Engineering Concepts in Sensory & Motor rehabilitation.

Module- II

Orthrotics & Prosthetics in Rehabilitation:

Intelligent prosthetic Knee, Prosthetic Hand, Advance and automated prosthetics and orthrosis, externally powered and Controlled orthrotics & prosthetics, -FES system, Restoration of Hand function, Restoration of standing and walking, Hybrid assistive system, (HAS), Myo electric Hand and arm prosthesis, Intellegent hand prosthesis(MARCUS)

Module- III

Mobility:

Electronic Travel Appliances (ETA) **:** Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Nottingham Obstacle Sensors, Electro cortical Prosthesis, Electro Roftalam, Polarized Ultrasonic Travel aids, Materials used for wheel chairs, Type of Wheel Chairs, design of wheel Chair, Tricycle, Walkers, Crutches.

Module- IV

Sensory Augmentation and Substitutions:

Classification of Visual Impairments, Prevention and cure of visual impairments, Visual Augmentation, Tactile vision substitution, auditory substitution and augmentation, tactile auditory substitution, Assistive devices for the visual impaired.

Module- V

Computer Application in Rehabilitation Engineering:

Interface in compensation for visual perception, Improvement of orientation and Mobility.

Module- VI

Rehabilitation Aids for Mentally Impaired:

Sleeping Aids, Walking Aids, Seating Aids, Postural Aids.

References:

1. Robinson C.J. , *'Rehabilitation Engineering'* (CRC Press) (1995).
2. Ballabio E., *'Rehabilitation Technology'* (IOS Press) (1993).
3. R.M Kennedy, *'Text Book of Biomedical Engineering',* First Edition (Glasgow and London, Blackie & Son Limited) (1980).
4. Richards Skalak & Shu Chien, *'Handbook Of Bio Engineering'* (Mcgraw-Hill (Tx)) (December 1986)

506210- C- Bio MEMS

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

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

Theory: 50 Marks (End Semester)

Elective- II

Module- I

OVERVIEW OF MEMS &MICRO SYSTEM

MEMS & Micro systems - typical MEMS & Micro system products. Introduction to the world of microsystems. Description of the design and fabrication of microsystems. Integration of fabrication processes.

Module- II

MATERIALS FOR MEMS AND MICROSYSTEMS

Introduction- Substrates and Wafers, Active Substrate Materials – silicon as a substrate Material, Silicon Compounds, Polymersphotoresists and Packaging Materials.

Module- III

MICROSYSTEMS FABRICATION PROCESSES

Photolithography, Photoresist, Mask design, Additive Processes - deposition, Subtractive Processes - etching, Modifying – doping,annealing, curing

Thin Film Deposition: Spin-on Films, Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD)

Module- IV

MICROMACHINING:

Bulk Micromachining, Surface Micromachining, High Aspect- Ratio Processes (LIGA), Polymer Micro/Nano Fabrication

Module- V

MICRO TOTAL ANALYSIS SYSTEMS (μTAS)

1. Components,
2. Micro Fluidies and Fluid control components (channels,pumps, valves),
3. μ-TAS: sample handling – (Microactuators examples -microvalves, micropumps, micromotors, Micro mixers, Microactivation methods),
4. μ-TAS: separation components,
5. μ-TAS: detection

Module- VI

MICRO/ NANO BIOSENSORS

Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Biosensing Principles and sensing methods, biosensors arrays and implantable devices.

CELL CHIPS

Cell handling and characterization systems, systems for biotechnology and PCR, polynucleotide arrays and genetic screening.

MICROSURGICAL TOOLS and MICRONEEDLES

DRUG DELIVERY and IMPLANTABLE DEVICES

MICROSYSTEM PACKAGING

Micro Systems Packaging (Types) – Essential Packaging Technologies (Types)

References:

1. Marc Madou, “Fundamentals of Microfabrication” by, CRC Press, 1997.Gregory Kovacs
2. “Micromachined Transducers Sourcebook” WCB McGraw-Hill, Boston, 1998.
3. Steven S. Saliterman, “ Fundamentals of BioMEMS and Medical Microdevices”, (SPIE Press Monograph Vol. PM153 by Wiley Interscience
4. A. Manz and H. Becker, Eds. Microsystem Technology in Chemistry and Life Sciences Spronger-Verlag, New York, 1999. ISBN: 3-540-65555-7.
5. Stephen D. Senturia, "Microsystem Design" by, Kluwer Academic Publishers, 2001.
6. M.-H. Bao, “Micromechanical Transducers: Pressure sensors, accelrometers, and gyroscopes” by Elsevier, New York, 2000.

506210- D- Wavelets for Bio- Signal Processing

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

Elective- II

Module- I

Continuous Wavelet Transform: Continuous time frequency representation of signals, The Windowed Fourier Transform, Uncertainty Principle and time frequency tiling, Wavelets, specifications, admissibility conditions, Continuous wavelet transform, CWT as a correlation, CWT as an operator, Inverse CWT.

Module- II

Discrete wavelet Transform: Approximations of vectors in nested linear vector spaces, Example of an MRA, Formal definition of MRA, Construction of genera orthonormal MRA, a Wavelet basis for MRA, Digital filtering interpretations- Decomposition and Reconstruction filters, examples of orthogonal basis generating wavelets, interpreting orthonormal MRA for Discrete time signals, Mallat algorithm Filter bank implementation of DWT

Module- III

Alternative wavelet representations- Biorthogonal Wavelets: biorthogonality in vector space, biorthogonal wavelet bases, signal representation using biorthogonal wavelet system, advantages of biorthogonal wavelets, biorthogonal analysis and synthesis, Filter bank implementation, Two dimensional Wavelets, filter bank implementation of two dimensional wavelet transform.

Module- IV

Lifting scheme: Wavelet Transform using polyphase matrix factorization, Geometrical foundations of the lifting scheme, lifting scheme in the z- domain, mathematical preliminaries for polyphase factorization, Dealing with Signal Boundary.

Module- V

Applications: Image Compression: EZW Coding, SPIHT, Wavelet Difference Reduction Compression Algorithm, Denoising, speckle removal, edge detection and object isolation, audio compression, communication applications – scaling functions as signaling pulses, Discrete Wavelet Multitone Modulation.

References:

1. Insight into wavelets: From theory to Practice- K P Soman and K I Ramachandran, Prentice Hall of India.
2. Wavelet Transforms: Introduction to theory and applications- R M Rao and A S Bopardikar, Pearson.
3. Wavelets and filter banks- G Strang and T Q Nguyen, Wellesley Cambridge Press, 1998.
4. Fundamentals of Wavelets: Thory, Algorithms and Applications- J C Goswamy and A K Chan, Wiley- Interscience publications, John Wiley and sons, 1999 .
5. Wavelets and Multiwavelets- F Keinert, SIAM, Chapman and Hall/CRC, 2004 .
6. Ten Lectures on Wavelets- Ingrid Daubechies, SIAM, 1990 .
7. Wavelet Analysis- The scalable structure of Information- H L Resnikoff, R. O. Wells,Jr., Springer, 2004.

506211- 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.

506212- 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

606201- Medical Imaging Techniques

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

Module- I

Physical Principals of Imaging:

Fundamentals of Physics and Radiation; Concepts of Radiation science; Radiographic definition and Mathematics review; Electromagnetic Radiation: Photons, Electromagnetic Spectrum, Wave Particle Duality; Interactions between Radiation and matters; Fundamentals of acoustic propagation; Interaction between sonic beams and matter; concepts of ultrasonic diagnostics.

Module- II

Imaging with X-Rays: X-ray tube: The generation: Electron-Target Interactions, X-ray emission spectrum: Characteristic x-ray spectrum, Bremsstrahlung x-ray spectrum, Factors affecting X-ray Emission Spectrum: Effect of mA, kVp, added filtration; X-ray unit: generators, filters and grids; Image intensifiers; X-ray detectors: Screen film detector, Image Intensifier; Radiographic techniques, quality and exposure.

X-ray Diagnostic Methods: Fluoroscopy: Fluoroscopy and Visual Physiology, Image intensifier tube and Multifield intensification; Angiography: Arterial access, Catheters, Contrast media; Mammography: Soft tissue radiography, Equipments: Target composition, Filtration grids, Photo timers, Image receptors; Xero radiography; Digital radiography; 3-D construction of images.

Module- III

Computed Tomography: Operational modes: First generation scanners, Second, Third, Fourth, Fifth generation scanners; System components: Gantry, Collimation; High Voltage generators; Image characteristics: Image matrix, CT numbers; Image reconstruction; Image Quality: Spatial resolution, Contrast resolution, System noise, Linearity, Spatial Uniformity.

Module- IV

Imaging with Ultrasonography: Piezoelectric effect; Ultrasonic transducers: Mechanical and Electrical matching,; The characteristics of transducer beam: Huygens principle, Beam profiles, Pulsed ultrasonic filed, Visualization and mapping of the Ultrasonic field; Doppler effect-Doppler methods; Pulse echo systems[Amplitude mode, Brightness mode, Motion mode &Constant depth mode]; Tissue characterization: velocity, Attenuation or absorption,
Scattering.

Module- V

Developments in Ultrasound technique: Color Doppler flow imaging: CW Doppler imaging device, Pulsed Doppler imaging system, clinical applications; Intracavity imaging: Design of the Phased array probe, Trans oesophageal, Tannsvaginal or Transrectal scanning; Ultrasound contrast media: Utilization of micro air bubbles, galactose microparticles and albumin encapsulated microairbubbles; 3-D image reconstruction; 2-D echo cardiography

Biological effects of Radiation and Ultrasound and its protection: Modes of Biological effects: Composition of the body and Human response to Ionizing radiation; Physical and Biological factors affecting Radiosensitivity, Radiation Dose-response relationships; Time variance of
radiation exposure; Thermal / Nonthermal effects due to cavitation in ultrasound fields; Designing of radiation protections and its procedures.

Module- VI

Advances in Imaging: Introduction to Magnetic Resonance Imaging, Introduction to MRI, Imaging Pulse sequence, Limitations of MRI, Radionuclide Imaging, Single Photon Emission Computed Tomography, Positron Emission Tomography. Physics of thermography,

References:

1. K. Kirk Shung, Michael B. Smith, Benjamin Tsui, *'Principles of Medical Imaging'* (Academic Press)
2. Stewart C. Bushong, *'Radiologic science for Technologists'*, (Mosby: A Harcourt Health Sciences Company).
3. Jeffery Papp, *'Quality Management: In the Imaging Sciences'*, (Mosby: A Harcourt Health Sciences Company)
4. Christensens , '*Physics of Diagnostic Radiology*', 4Rev Ed edition (Lea & Febiger,U.S.), (Jun 1990)
5. David J. Dowsett, Patrick A. Kemmy, R. Eugene Jhnston, *'The Physics of Diagnostic imaging'* , Second Edition, (A Hodder Arnold Publication)
6. W.J. Meredith & J. B. Massey, *'Fundamental physics of radiology'* (Varghese Publisher)
7. Jole Pierce Jones, *'Acoustic Imaging'*, (Plenum Publishing)

606202- Advanced Digital Signal Processing

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

Module- I

Introduction: Time frequency analysis, the need for time frequency analysis, Time frequency distribution, Short time Fourier Transform, Wigner distribution.

Module- II

Multirate digital signal processing: Basic multirate operation (up sampling, down sampling), Efficient structures for decimation and interpolation, Decimation and interpolation with polyphase filters, Noninteger sampling rate conversion , Efficient multirate filtering Applications, Oversampled A/D and D/A converter

Module- III

Stochastic Processes: Introduction, WSS signals and linear systems, spectral factorization, models of stochastic processes, vector processes.

Module- IV

Spectral estimation: Periodogramm-based nonparametric methods: Periodogram, Bartlett's method, Welch's method, Blackman-Tukey method . Parametric methods for power spectrum estimation: ARMA modeling, Yule- Walker equation and solution.

Module- V

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- VI

Applications: International Standards for speech, image and video compression for personnel communication, Digital broadcasting and multimedia systems

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)
3. Leon Cohen, *"Time Frequency Analysis"*, (Prentice Hall), (1995).
4. Haykins, *"Adaptive Filter theory",* (Prentice Hall) (1986)
5. J. Proakis , Charles M. Rader, Fuyun Ling, Christopher L. Nikias, *'Digital Signal Processing*', (Macmillan Coll Div)
6. A.V.Oppenheim and R.W.Schafer, *"Discrete time Signal Processing*", (Prentice Hall) (1992)
7. P.P. Vaidyanathan, *"Multirate systems and Filter banks"*, (Prentice Hall) (1993)
8. Steven M . Kay , *"Modern Spectrum Estimation"*, (Prentice Hall) (1988)

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

606204- 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.

606205- 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

606206- 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.

606207- 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)