FACULTY OF ENGINEERING

Syllabus for the

M.E (Instrumentation & Control)

(w.e.f 2008-2009)

UNIVERSITY OF PUNE
THE SYLLABUS IS PREPARED BY:

BOS- Instrumentation Engineering
University of Pune

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Note:- This syllabus is subject to change without prior notice by the concerned BOS
Faculty of Engineering
## COURSE STRUCTURE
### M.E. (Instrumentation & Control) (Process Instrumentation)( 2008 Course)

### SEMESTER I

<table>
<thead>
<tr>
<th>CODE</th>
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* The Term Work of Project stage II of semester IV should be assessed jointly by the pair of internal and external examiners, along with the oral examination of the same.

**Note:** The Contact Hours for the calculation of load of teacher
- Seminar - 1 Hr / week / student &
- Project - 2 Hr / week / student

### List of Elective Subjects

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<th>Sr. No.</th>
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<td>Modern Control Theory</td>
<td>Advanced Process Instrumentation</td>
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<td>B</td>
<td>Building Automation</td>
<td>Mechatronics</td>
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<tr>
<td>A</td>
<td>Fundamentals of Biomedical Instrumentation</td>
<td>Biosignal Processing</td>
<td>Bio-imaging Modality</td>
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<td>B</td>
<td>Introduction to Physiology and Anatomy</td>
<td>Rehabilitation Engineering</td>
<td>Biophotonics</td>
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The subjects of ME (Instrumentation & Control) (Process Instrumentation) having code 5061101, 5061102, 5061103, 5061104, 5061108, 5061109 and 5061110 are common for M.E. (Instrumentation & Control) (Biomedical Instrumentation).
1. 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


3. 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

4. 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.


Text Books:

Reference Books:
(5061102) Mathematical Methods in Instrumentation

Teaching scheme: 3 lectures/week      Credits: 3
Exam scheme: Paper- 100 marks

1. 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.


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

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

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

Reference Books:

(5061103) Communication Protocols for Instrumentation

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks

Credits: 3


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


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

References/Books

(5061104) Analytical Instrumentation

Teaching scheme: 3 lectures/week  
Exam scheme: Paper- 100 marks  
Credits: 3

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

2. Absorption methods:  
   b. IR spectrometry: correlation of IR spectra with molecular structure, Instrumentation.  
   c. Atomic absorption spectrometry: Principle, Instrumentation

3. Emission methods: Flame, AC/DC arc, spark, plasma excitation sources, instrumentation


5. Mass spectrometer: Ionisation methods, mass analysers, mass detectors, FTMS.

6. Chromatography: Classification, Gas chromatography, Liquid chromatography, Instrumentation

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

8. NMR spectroscopy: Principle, chemical shift, spin-spin coupling, instrumentation, types of NMR.


Text books:  

(5061105-A) Industrial Automation

Teaching scheme: 3 lectures/week  
Exam scheme: Paper- 100 marks  
Credits: 3

1. Introduction: Introduction to automation tools PLC, DCS, SCADA, Hybrid DCS/PLC.

2. DCS Project: Development of User Requirement Specifications, Functional Design Specifications for automation tool, GAMP, FDA.


4. DCS: Introduction to architecture of different makes, DCS Specifications, configuration of DCS blocks for different applications, Interfacing of protocol based sensors, actuators and PLC systems, Plant wide database management, Security and user access management, MES, ERP Interface.
5. Study of Advance Process control blocks: Statistical Process Control, Model Predictive Control, Fuzzy Logic Based Control, Neural-Network Based Control

Higher Level Operations: Control & Instrumentation for process optimization Applications of the above techniques to the some standard units/processes

Reference Books:

1. Gary Dunning, ‘Introduction to Programmable logic Controllers’, (Delmar Publisher)
2. Webb & Reis, ‘Programmable logic Controllers’, (Prentice Hall of India)
3. Jose A. Romagnoli, Ahmet Palazoglu, ‘Introduction to process Control’ (CRC Tylor and Francis group)
5. B.G. Liptak ‘Handbook of Instrumentation- Process Control’
6. Installation and user manuals of different DCS, PLC Vendors

(5061105-B) Building Automation

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks

Credits: 3


Text Book:


(5061105-C) Geo Technical Instrumentation

Teaching scheme: 3 lectures/week Credits: 3
Exam scheme: Paper- 100 marks


3. Pore pressures, Total Pressures, Earth Pressures

4. Stress, Strain, Displacements, Load, Deformations, Tilt, Inclination, Slope, Depth, Bore Diameters.
5. Temperature, Salinity, Conductivity, pH value
6. Various methods of measuring these parameters such as: Hydraulic Methods, Pneumatic Methods, Resistance Devices using Carlson Techniques, Vibrating Wire Techniques, Piezo Resistance Techniques, Optical Fiber Based Sensing Techniques

7. Digital and Analogue data acquisition Techniques for above parameters

8. Micro controller based Data Acquisition Systems and data Presentation Systems

9. Computer Based Data analyzers

**Text Books and Reference Books:**
1. T H Hanna, ‘Field Instrumentation’, (Trans Tel (Germany) Publications)
2. Various Civil Engineering Conference reports including Conferences on Large Dams
3. BIS Standards and British Standards

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(5061106) Lab Practice-I

Teaching Scheme: 6 Hrs/week  
Term-work: 50 marks

Credits: 03

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.

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(5061107) Seminar-I

Working load: 4 Hrs/week  
Term-work:50 marks

Credits: 02

The term-work will consists of a report prepared by every student on a seminar topic allotted and oral presentation. The student is expected to submit the seminar report in standard format approved by the university. The topic of the should be out of the syllabus and relevant to the latest trends in Instrumentation and control.

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(5061108) Control System Design

Teaching scheme: 3 lectures/week  
Exam scheme: Paper- 100 marks

Credits: 3

1. Design concepts in continuous time control systems:
2. Controller Design: Direct controller synthesis, Internal model controller design, Decoupler design
3. 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.
4. Design concepts in discrete time control systems:
Controller Design: Direct controller synthesis, Discretization of continuous controller,  5. Deadbeat 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.
6. Advances in control system design:
   Model predictive controller, Concepts of robust control, H-infinity design technique

Text/Reference Books:

(5061109) Advanced Signal Processing

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks

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

2. 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.


   Parametric methods for power spectrum estimation: ARMA modeling, Yule-Walker equation and solution.


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

Text Books:

Reference Books:

(5061110) Organisational Behaviour & Management

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks
Credts: 3

1. Management: Management functions, roles and skills of management, Effective versus successful managerial activities, manager’s job

2. Organisational Behaviour: Replacing intuition with systematic study, contributing disciplines to the OB field, challenges and opportunities for OB, developing an OB model.

3. The Individual:
   a. Foundations of individual behaviour, biographical characteristics, ability, learning, values, attitudes and job satisfaction, personality and emotions, perception and individual decision making.
   b. Motivation: Theories of motivation, motivation from concepts to applications.

4. The Group: Foundations of group, stages of group development, group structure, group processes, group tasks, group decision techniques, understanding work teams, communication, basic approaches and contemporary issues in leadership, power and politics, conflict and negotiation.
5. The organization System: Foundations of organization structure, work design and technology, human resource policies and practices, organisational culture.


7. Case Study: Case problems provide a useful medium for testing and applying some of the ideas of the syllabus. It is expected that students will discuss some case problems in the class.

Text Books:

**Teaching scheme**: 3 lectures/week  
**Credits**: 3  
**Exam scheme**: Paper- 100 marks


2. Discrete time control systems: sampling theorem, pulse transfer function, modified Z-transform, stability analysis.


Reference Books:

(5061111-B) Mechatronics

Teaching scheme: 3 lectures/week Credits: 3
Exam scheme: Paper- 100 marks

1. Introduction: definition, trends, control systems, micro-controller based controllers, PC based controllers.

2. Design of sensor and signal conditioning for Displacement, position, velocity, force, pressure, temperature.


4. Electro mechanical drives: relays and solenoid, stepper motors, DC-brushed / brushless motors, DC servo motors, breaking methods, PWM, Bi-polar driver, MoSFET drivers, SCR drivers, Variable Frequency Drives.

5. Micro-controller and interfacing: Digital signal interfacing techniques, Analog signal interfacing with ADC and DAC.

6. Programmable logic and motion controller: programming, interfacing of sensors and actuators to PLC, Simultaneous control of axes integration of axes and I/Os.

Textbooks:

(5061111-C) Robotics

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks
Credits: 3

1. Introduction and overview of robots: coordinate frames, mapping and transforms.
3. Workspace and trajectory planning: workspace fixtures pick and place operation, continuous path and interpolated motion.
4. Robotic sensors and vision: sensors in robotics, position and motion sensors, proximity sensors, touch and slip sensors, force and torque sensors, vision controlled robotic system.
5. Control of actuators and manipulators: open and close loop control, joint actuators, control schemes.

Text books:

(5061112-A) Advance Process Control

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks
Credits: 3

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

Multivariable Process control: Cascade control, Ratio control, feedback-feedforward control, override control, selective control, modeling of multivariable process, Design of Multivariable controllers.

Model Based control: Feedback-feedforward, delay compensation, Internal Model controller (IMC): Concept, IMC design Procedure.

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


Case study: Design of Fuzzy-Logic based controller.

Case study: Design of Neural Network based controller.

Reference/Books

2. Jose A. Romagnoli, Ahmet Palazoglu, ‘Introduction to process Control’ (CRC Tylor and Francis group)
3. Statistical Process Control –ISA
4. B.G. Liptak, ‘Handbook of Instrumentation- Process Control’

(5061112-B) Automobile Instrumentation

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks

1. Basics of Automobile.
2. Engine Control management: fuel control, ignition control, exhaust control, angular and linear position sensors and control valves, pressure sensors, cam shaft and crank shaft sensors, wheel speed sensors.
3. Power transmission strategies and control.
4. Interior and exterior lighting systems: sensing and instrumentation.
5. Aerodynamics and Ergonomics.
7. Support accessories.
Texts books:


(5061113) Lab Practice-II

Teaching Scheme: 6 Hrs/week Term-work: 50 marks
Credits: 03
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.

(5061114) Seminar-II

Working load: 4 Hrs/week Term-work: 50 marks
Credits: 02
The term-work will consists of a report prepared by every student on a seminar topic allotted and oral presentation. The student is expected to submit the seminar report in standard format approved by the university. The topic of the should be out of the syllabus and relevant to the

(6061101) Seminar-III

Working load: 4 Hrs/week Term-work: 50 marks
Credits: 02
The term-work will consists of a report prepared by every student on a seminar topic allotted and oral presentation. The student is expected to submit the seminar report in standard format approved by the university. The topic of the should be out of the syllabus and relevant to the

(6061102)Project Stage-I

Working: 18 Hrs./week Term-work: 50 marks
Credits: 06
The project stage-I is the integral part of the dissertation project. The project should be based on the knowledge acquired by the student during the coursework and should contribute to the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems in an area where the student like to acquire specialized skills.
The student should present the progress of the project. It will consist of problem statement, literature survey, project overview and scheme of implementation (block diagram, PERT chart etc.)

(6061103) Project Stage-II

Working: 18 Hrs/week Term-work: 150 marks
Credits: 12 Oral: 50 marks

The project will be evaluated on the basis of
1. Understanding of the problem statement
2. Physical inspection of the project
3. Project report
4. Oral examination

Term work will be assessed jointly by a pair of internal and external examiners along with the oral examination of the same.

(5061201-A) Fundamentals of Biomedical Instrumentation

Teaching scheme: 3 lectures/week Credits: 3
Exam scheme: Paper- 100 marks

Biotransducers:

2. Thermo resistive transducer: RTD and Thermister, Thermo emf Transducer- thermo couples; Non contact type infrared thermometry; Optical pyrometer. Thermistor used for cardiac output measurement, nasal air flow measurement.

3. Inductive Transducers: LVDT- construction, sensitivity, merits variable inductance method etc.

4. Capacitive Transducer: variable separation, variable area and variable dielectric type; merits and demerits. Diaphragm type capacitive pressure transducer

5. Piezoelectric Transducer: Piezo crystals- output equation, mode of operation, merits and demerits.

Biopotential Measurement:
1. 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.

B) Biomedical Instrumentation

1. 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; Blood pressure measurement techniques, Foetal heart rate measurements Plethysmography. Cardiac Pacemakers, Defibrillators, Heart- Lung Machine (HLM)


Pulmonary Function Analyzers:
1. Natural Process of Breathing, O$_2$ and CO$_2$ Transport, Regulation of Breathing, Pulmonary function measurement; Spirometry; Pulmonary function analyzers. Respiratory gas analyzers. Ventilators

Blood Flow meters and Cell Counters:

3. Methods of Cell counting- Coulter Counters; Automatic recognition and differential counting of cells; Auto analyzer.

Nervous System
1. Structure of Neuron, Central Nervous System, Electroencephalography, Evoked Response, Biofeedback

2. Myoelectric voltages, Electromyography

3. Electrical safety:- Significance of Electrical Danger, Physiological Effect of Current, Ground Shock Hazards, Methods of Accident Prevention


Sensory Instrumentation:
Mechanism of Hearing, Sound Conduction System, Basic Audiometer; Pure tone audiometer; Audiometer system Bekesy; Evoked response Audiometer system, Hearing Aids
Anatomy of Eye, Errors in Vision, ophthalmoscope, Tonometer, Perimeter,

Text/Reference Books:


Reference Books:

(5061201-B) Introduction to Physiology and Anatomy

Teaching scheme: 3 lectures/week      Credits: 3
Exam scheme: Paper- 100 marks

1. a) 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 of Excitability; Recording Membrane potentials and Action potentials.
   b) Skeletal and Muscular System: Structure and Formation of bone, Types of bones, joints, Classification of movements, Classification of muscles- Muscle contraction mechanism, EMG.
   c) 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.


3. 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, 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.


Hearing: Tympanic membrane and the Ossicular system, the cochlea, Hearing mechanics and abnormality, Deafness, Audiometry.

7. 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.

Text/Reference Books:


(5061202) Lab Practice-I

Teaching Scheme: 6 Hrs/week Term-work: 50 marks
Credits: 03
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.

(5061203) Seminar-I

Working load: 4 Hrs/week Term-work: 50 marks
Credits: 02
The term-work will consists of a report prepared by every student on a seminar topic allotted and oral presentation. The student is expected to submit the seminar report in standard format approved by the university. The topic of the should be out of the syllabus and relevant to the latest trends in Instrumentation and control.
(5061204-A) Bio signal Processing

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks
Credits: 3

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

2. 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.

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

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.
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.
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.

5. Data reduction techniques, Finite word length effects. Commercial DSP processors.

Text/Reference Books :
2. Oppenheim & schafer, ‘Digital signal processing’ (Prentice Hall)

(5061204-B) Rehabilitation Engineering

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks
Credits: 3

1. Introduction to Rehabilitation:
Definition, Concept of Rehabilitation: Orthosis & Prosthesis, Types of Physical Impairments, Engineering Concepts in Sensory & Motor rehabilitation.
2. Orthotics & Prosthetics in Rehabilitation:
Intelligent prosthetic Knee, Prosthetic Hand, Advance and automated prosthetics and orthosis, externally
powered and Controlled orthotics & prosthetics, -FES system, Restoration of Hand function, Restoration
of standing and walking, Hybrid assistive system, (HAS), Myo electric Hand and arm prosthesis,
Intelligent hand prosthesis(MARCUS)

3. 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.

4. 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.

5. Computer Application in Rehabilitation Engineering:
Interface in compensation for visual perception, Improvement of orientation and Mobility.

6. Rehabilitation Aids for Mentally Impaired:
Sleeping Aids, Walking Aids, Seating Aids, Postural Aids.

Text Books
Son Limited) (1980)

(5061205-A) Bio-imaging Modality

Teaching scheme: 3 lectures/week
Exam scheme: Paper- 100 marks

1. 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.
2. Imaging with X-Rays:

3. 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.

4. 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.

5. 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.

6. 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, Transvaginal 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

7. 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.

8. Advances in Imaging:

Text/Reference Books:
6. W.J. Meredith & J. B. Massey, *Fundamental physics of radiology* (Varghese Publisher)

(5061205-B) Biophotonics

Teaching scheme: 3 lectures/week         Credits: 3
Exam scheme: Paper- 100 marks

A. Laser Physics:
2. Interaction of Laser with Tissue:
   Non- Thermal and thermal effects:
   Photochemical effect, photo mechanical effect, coagulation, evaporation,

B. 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.

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

Text/ Reference books

2. *Introduction to LASERs*, AICTE- CEP Publication
(5061206) Lab Practice-II

Teaching Scheme: 6 Hrs/week  Term-work: 50 marks
Credits: 03
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.

(5061207) Seminar-II

Working load: 4 Hrs/week  Term-work: 50 marks
Credits: 02
The term-work will consists of a report prepared by every student on a seminar topic allotted and oral presentation. The student is expected to submit the seminar report in standard format approved by the university. The topic of the should be out of the syllabus and relevant to the

(6061201) Seminar-III

Working load: 4 Hrs/week  Term-work: 50 marks
Credits: 02
The term-work will consists of a report prepared by every student on a seminar topic allotted and oral presentation. The student is expected to submit the seminar report in standard format approved by the university. The topic of the should be out of the syllabus and relevant to the

(6061202) Project Stage-I

Working: 18 Hrs./week  Term-work: 50 marks
Credits: 06
The project stage-I is the integral part of the dissertation project. The project should be based on the knowledge acquired by the student during the coursework and should contribute to the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems in an area where the student like to acquire specialized skills.

The student should present the progress of the project. It will consist of problem statement, literature survey, project overview and scheme of implementation (block diagram, PERT chart etc.)
Working: 18 Hrs/week  
Credits: 12  

Term-work: 150 marks  
Oral: 50 marks  

The project will be evaluated on the basis of  
   5. Understanding of the problem statement  
   6. Physical inspection of the project  
   7. Project report  
   8. Oral examination  

Term work will be assessed jointly by a pair of internal and external examiners along with the oral examination of the same.