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)

SEMISTER I

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
5061101	Transducer Design	3	-	100	-	-	-	100	3
5061102	Mathematical Methods in Instrumentation	3	-	100	-	-	-	100	3
5061103	Communication Protocols for Instrumentation	3	-	100	-	-	-	100	3
5061104	Analytical Instrumentation	3	-	100	-	-	-	100	3
5061105	Elective I	3	-	100	-	-	-	100	3
5061106	Lab Practice I	-	6	-	50	-		50	3
5061107	Seminar I	-	4	-	50	-	-	50	2
Total of First Term		15	10	500	100	-	-	600	20

SEMISTER II

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
5061108	Control System Design	3	-	100	-	-	-	100	3
5061109	Advanced Signal Processing	3	-	100	-	-	-	100	3
5061110	Organisational Behaviour & Management	3	-	100	-	-	-	100	3
5061111	Elective II	3	-	100	-	-	-	100	3
5061112	Elective III	3	-	100	-	-	-	100	3
5061113	Lab Practice II	-	6	-	50	-		50	3
5061114	Seminar II	-	4	-	50	-	-	50	2
Total of Second Term		15	10	500	100	-	-	600	20

SEMISTER III

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
6061101	Seminar III	-	4	-	50	-	-	50	2
6061102	Project Stage I	-	18	-	50	-		50	6
Total of Third Term		-	22	-	100	-	-	100	08

SEMISTER IV

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
6061103	Project Stage II	-	18	-	150*	50		200	12
Total of Fourth Term		-	18	-	150	50	-	200	12

* 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

Sr. No.	ELECTIVE 1 (5061105)	ELECTIVE 2 (5061111)	ELECTIVE 3 (5061112)
A	Industrial Automation	Modern Control Theory	Advanced Process Instrumentation
B	Building Automation	Mechatronics	Automobile Instrumentation
C	Geotechnical Instrumentation	Robotics	(Open Elective)

COURSE STRUCTURE

M.E. (Instrumentation & Control) (Biomedical Instrumentation)(2008 Course)

SEMISTER I

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
5061101	Transducer Design	3	-	100	-	-	-	100	3
5061102	Mathematical Methods in Instrumentation	3	-	100	-	-	-	100	3
5061103	Communication Protocols for Instrumentation	3	-	100	-	-	-	100	3
5061104	Analytical Instrumentation	3	-	100	-	-	-	100	3
5061201	Elective I	3	-	100	-	-	-	100	3
5061202	Lab Practice I	-	6	-	50	-		50	3
5061203	Seminar I	-	4	-	50	-	-	50	2
Total of First Term		15	10	500	100	-	-	600	20

SEMISTER II

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
5061108	Control System Design	3	-	100	-	-	-	100	3
5061109	Advanced Signal Processing	3	-	100	-	-	-	100	3
5061110	Organisational Behaviour & Management	3	-	100	-	-	-	100	3
5061204	Elective II	3	-	100	-	-	-	100	3
5061205	Elective III	3	-	100	-	-	-	100	3
5061206	Lab Practice II	-	6	-	50	-		50	3
5061207	Seminar II	-	4	-	50	-	-	50	2
Total of Second Term		15	10	500	100	-	-	600	20

SEMISTER III

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
6061201	Seminar III	-	4	-	50	-	-	50	2
6061202	Project Stage I	-	18	-	50	-		50	6
Total of Third Term		-	22	-	100	-	-	100	08

SEMISTER IV

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
6061203	Project Stage II	-	18	-	150*	50		200	12
Total of Fourth Term		-	18	-	150	50	-	200	12

* 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

Sr. No.	ELECTIVE 1 (5061201)	ELECTIVE 2 (5061204)	ELECTIVE 3 (5061205)
A	Fundamentals of Biomedical Instrumentation	Biosignal Processing	Bio-imaging Modality
B	Introduction to Physiology and Anatomy	Rehabilitation Engineering	Biophotonics
C			(Open Elective)

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).

(5061101) Transducer Design

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

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

2**.** 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

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.

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

6. 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.

Text Books:

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. Sarma and V.S.V. Mani *'Instrumentation Devices and Systems'*, Tata Mcgraw-Hill Publishing Company Ltd. New Delhi (1983).

Reference Books:

1. J. Wilson, J.F.B. Hawkes, *'Laser Principles and Applications'*,.(Prentice-Hall, New York), (1987)
2. J. Wilson, '*Optoelectronics'*, 2nd Edition,(Prentic-Hall, India) (1999)

(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.

2. 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.

3. 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-Bashforth method.

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:

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), (2004).
8. Miller I & Freund J., '*Probability & Statistics For Engineering'*. (Prentice Hall Of India New Delhi), (1987).
9. Walpole R. E., Myers R. H. & Myers S. L., *'Probability & Statistics For Engineers & Scientist'*. (Prentice Hall Inc. New Jercy), (1998).

(5061103) Communication Protocols for Instrumentation

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

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

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

3. 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.

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

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

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

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

References/Books

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.

(5061104) Analytical Instrumentation

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

1. Introduction: Introduction to chemical analysis, Classical and Instrumental methods, Classification of Instrumental techniques, important considerations in evaluating an instrumental method,
2. 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
3. Emission methods: Flame, AC/DC arc, spark, plasma excitation sources, instrumentation
4. Spectrofluroscence and phosphorescence spectrometer: Instrumentation, Raman spectrometer.
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.
9. Electroanalytical methods: potentiometry, voltammetry, coulometry techniques.

Text books:

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)

(5061105-A) Industrial Automation

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

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.

3. 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 of PLC with SCADA software.

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)
4. Statistical Process Control –ISA Handbook
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 Credits: 3
Exam scheme: Paper- 100 marks

1. Introduction: Introduction to Building Automation System, Features, Characteristics, Drawbacks of Building Automation system. Various Systems of Building Automation – Building Management System, Energy Management System, Security System, Safety System, Video Management System.

2. Building Management System: Introduction, HVAC, Sensors & Transducers – Temperature, Pressure, Level, Flow, RH. Meaning of Analog & Digital Signals, Valves and Actuators, Valve & Actuator Selection, Various Controllers, Concept of Controller IOs, Std Signals, Signal Compatibility between Controller & Field Devices. AHU – Concept, Components, Working Principle. AC Plant Room – Concept, Components, Refrigeration Cycle Working Principle, Chiller Sequencing, AC Plant Sequencing. Feedback Control Loops, Heat – Types, Heat Transfer Principles, Measurement of Heat Transfer. Psychrometry – Concept, ASHRAE Psychrometric Chart, Meaning of Various Terms – DBT, WBT, ST, RH, DPT, Sensible & Latent Cooling & Heating, Numericals. Job IO Summary Calculation, Controller Sizing, AI to DI Conversion, Cable Selection, Earthing – Meaning, Importance, Panel Earthing, EMI & Tackling EMI. Logic Examples, CL Programming.

3. Energy Management System: Concept, Energy Meters, Types, Meter Networking, Monitoring Energy Parameters, Analysis of Power Quality – Instantaneous Power, Active Power, Reactive Power, Power Factor, Voltage, Current. Effect of Power Quality on Energy Consumption, Energy Reports, Energy Conservation, Importance of Energy Saving.

4. Safety Systems**:** Introduction, Fire –Meaning, Fire Development Stages, Fire Sensors & Detectors, Detector Placement, Detectors Required For Various Applications. Fire Extinguishing Principles, Fire Extinguishers & Its Classification. Fire Alarm System – Controllers, Components, Features, Concept of Fire Loop & Fire Devices, 2-Wire & 4-Wire Loops, Working Principle, System Description, Pre-alarm, Alarm, Trouble, Fault, Differences, Cable Selection, Installation Guidelines Best Installation Practices, Logic Example. NFPA and IS2189 Stds, System Programming.

5. Security Systems: Introduction, Access Control – Concept, Generic Model, Components, Types, Features, Card Technologies, Protocols, Controllers, Concept of Antipassback, Biometrics, Issues With Biometrics, Cabling, Video Door phone, Intrusion Detection System – Sensors, Working Principle, Access Control System Programming.

6. Video Management: Introduction, CCTV Cameras, CCD Camera Basics, Traditional CCTV System, Video Recording, Drawbacks, Digital Video Recording, Features, Functionalities, Digital Vs Analog Recording, Digital Video Management System – Introduction, Features, Advancements & Differences from Earlier Video Techniques, TCP/IP Networking Fundamentals, System Network Load Calculations, Network Design.

7. Integrated Systems: Introduction, Integration of Building Management System, Energy Management System, Safety System, Security Systems & Video Management, Benefits of Integrated Systems, Challenges, Future Prospects of Integrated Systems

8. Project Lifecycle Management: Meaning, Project Lifecycle – Sales Process, Sales Project Handover, Materials Requirement, Project Funding, Budgeted Cost, PR, PO, Material Lead Time, Engineering Submittals, 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

Text Book:

1. Reinhold A. Carlson Robert A. Di Giandomenico, '*Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, Building'*, 1st edition (R.S. Means Company Ltd), (1991)

(5061105-C) Geo Technical Instrumentation

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

1. Review of Requirement of Field /Geotechnical Instrumentation in construction, soil and rock mechanics. Brief Review of Dam and Large structure design parameters, Objective and Purpose of Geo instrumentation.

2. Measurement of Parameters for: Earth and Rock fill Dams, Concrete Dam, Gravity Dam, Earthen Embankments, Large structures like Multi storied Buildings, Large structures Like Big Sports Stadiums , Canal, Tunnels for Road and Railways, Airport Tarmacs, Express Motorways.

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

(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.

(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.

(5061108) Control System Design

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

1. Design concepts in continuous time control systems:
Design of compensators: Lead Compensator, Lag compensator and Lag-Lead compensator using root locus and Bode plot.

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

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. Gopal.M., *'Digital control Engineering'* , (Wiley Eastern Ltd.) (1989).
6. G.F.Franklin, J.David Powell, Michael Workman, *'Digital control of Dynamic Systems'*, 3rd Edition, (Addison Wesley) (2000).
7. Forsytheand W. and Goodall R.N., *'Digital Control'*, (McMillan) (1991).
8. M.Gopal, *'Digital Control and State Variable Method'*, (Tata-McGraw Hill, Delhi) (1997).
9. Contantine H. and Gary B. Lamont, *'Digital Control Systems'*, Second Edition, (McGraw-hill International) (2002).
10. Bequette, B.W. Process Control,Modeling, *'Design and Simulation'*, (Prentice Hall of India) (2004).

(5061109) Advanced Signal Processing

Teaching scheme: 3 lectures/week Credits: 3
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.

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

4. 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.

5. 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.

6. Multiresolution Signal analysis, Decompositions, transforms , Subbands and wavelets, Orthogonal transforms : Cosine , sine , Hermite Walsh Fourier, Theory of subband decomposition , decimation , interpolation , Design of QMF filter banks ,Wavelet transforms .

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

Text Books:

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)

Reference Books :

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

(5061110) Organisational Behaviour & Management

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

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.

6. Organisational Dynamics: Organisational change and stress management, historical evolution of organisational behaviour.

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:

1. Stephen P. Robbins, *'Organizational Behaviour'*, 10th edition, (Pearson Education Inc.) (2004).
2. Keith Davis, *'Human Behaviour at Work'*, 5th edition, (Tata McGraw-Hill Publishing Co. Ltd. New Delhi) (1977)

(5061111-A) Modern Control Theory

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

1. State Space analysis of continuous time multivariable systems: State equations for dynamic systems, State equations using phase, physical and canonical variables, realization of transfer matrices, Minimal realization, Solution of state equation, concepts of controllability, reachability, observability, Controllability and Observability tests: Kalman's test matrix, Gilbert's test, Popov-Belevitch-Hautus test, stability.

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

3. State space analysis of discrete time multivariable systems: Discretization of State equations for dynamic systems, State equations using phase, physical and canonical variables, realization of transfer matrices, Minimal realization, Solution of state equation, stability.

4. State Space and Matrix-Fraction Descriptions of Multivariable systems: State observability, controllability and matrix-fraction descriptions, Some properties of polynomial matrices, Some basic state space realization, The Smith-McMillan form of a transfer function matrix, Poles and Zeros of a transfer function matrix, Matrix-fraction description (MFD) of a transfer function, State space realization from a transfer function matrix, Internal stability, The generalized Nyquist and inverse Nyquist stability criterion.

5. Controller parameterization: Affine parameterization for stable systems, PID synthesis using Affine parameterization, Affine parameterization for systems with dead time. Affine parameterization of multivariable control systems.

Reference Books:

1. Chen C. T., '*Linear Systems: Theory & Design*', (Oxford University Press New York), (1999).
2. Gopal M., '*Modern Control Systems Theory*', (New Age International New Delhi) (1995).
3. Goodwin , Graebe S F & Salgado M E, '*Control Systen Design*', (Prentice hall of India, Delhi) (2002).
4. Ogata K., '*Discrete Time Control Systems*', (Prentice Hall of India, Delhi) (2004).

5. Ogata K., Modern Control Engineering. (Prentice Hall Of India Pvt.ltd.) (1992).
6. Gopal.M., '*Digital control Engineering*', (Wiley Eastern Ltd.) (1989).
7. G.F.Franklin, J.David Powell, Michael Workman, '*Digital control of Dynamic Systems'*, 3rd Edition, (Addison Wesley), (2000).
8. M.Gopal, '*Digital Control and State Variable Method'*, (Tata-McGraw Hill, Delhi),(1997).
9. Shinners S M, '*Modern Control System: Theory & Design'*, (John Wily & Sons, New York), (1992).

(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.

3. Precision mechanical actuation: Pneumatic, Electro-pneumatic, Hydraulic, Electro-hydraulic actuation systems, ball screw and nut, linear motion guides, linear bearings, bearings, harmonic transmission, motor/drive selection.

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:

1. Devid G. Alciatore, Michael B. Histand , '*Introduction to Mechatronics and measurement systems*', 2nd Edition, (Mc-GRAW-HILL) (2003)
2. Bella G Liptak, '*Instrument Engineer' Handbook, Vol 1,2 and 3'*, 3rd edition, (CRC Press) (2002).
3. Ajay V. Deshmukh, '*Microcontrollers*', 1st edition, (Tata McGraw-Hill) (2005).

(5061111-C) Robotics

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

1. Introduction and over view of robots: coordinate frames, mapping and transforms.

2. Symbolic modelling of robot: direct and inverse kinematics models, dynamic modelling, manipulator differential motion and statistics.

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.

6. Principles of robot application and safety: material handling, application for process, Assembly, inspection.

Text books:

1. R.K.Mittal and I.J.Nagrath, '*Robotics and control'*, second edition reprint , (Tata McGraw-hill), (2005) .
2. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, '*Robotic engineering',* (Prentice-Hall of India), (2001).
3. Robert j. Schilling, '*Fundamentals of Robotics'*, (Prentice-Hall of India Pvt. Ltd), (2000).

(5061112-A) Advance Process Control

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

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

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

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.

Statistical Process Control (SPC): Concept, Design procedure.

Case study: Design of Fuzzy-Logic based controller.

Case study: Design of Neural Network based controller.

Reference/Books

1. Thomas E. Marlin *'Process Control'*, (McGraw-Hill International Edition)
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'*
5. Les A. Kane, *"Handbook of Advanced Process Control Systems and Instrumentation"* (Springer)

(5061112-B) Automobile Instrumentation

Teaching scheme: 3 lectures/week Credits: 3
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.
6. Security and Safety controls: keyless sensors for passive entry.
7. Support accessories.

Texts books:

1. William B. Riddens, *'Understanding Automotive Elctronics'*, 5th Edition, (Butterworth Heinemann Woburn), (1998).
2. Tom Weather Jr and Cland C. Hunter, *'Automotive Computers and Control System'*, (Prentice Hall Inc.NewJeresy).
3. Jiri Marek, Hans Peter trah, *'Sensers Applications, Sensers for Automotive Technology'*, 1st Edition (Wiley –VCH)

(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:

1. Transduction Principles**:** Resistive Transducers Strain Gauge- types, construction, selection materials, Gauge factor, Bridge circuit, Temperature compensation. Strain Gauge type Blood pressure transducers.

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.

2. Body Surface recording electrodes for ECG, EMG, EEG. Electrodes standards. Internal Electrodes- needle and wire electrodes. Micro electrodes- metal microelectrodes, micro pipette electrodes. Electrical properties of micro electrodes. Electrodes for electric simulation of tissue; Methods of use of electrodes.

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 Pacemakars ,Defibrillators, Heart- Lung Machine (HLM)

2. 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 :
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 :

2. Electromagnetic Blood flow meters; Ultrasonic Blood Flow meters; NMR Blood Flow meters; Laser Doppler Blood Flow Meters.

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

4. Kidney Instrumentation: Kidney Structure, Regulation of Water and Electrolyte Balance, Artificial Kidney, Dialysis System, Lithotripsy

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:

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).
Reference Books:
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)
8. S.K.Venkata Ram, '*Biomedical Electronics and Instrumentation'*, (Galgotia Publication Pvt. Ltd. New Delhi).
9. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, *'Biomedical Instrumentation and Measurements'*, 2 edition, (Prentice-Hall India) (1997)

(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.

2. 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.

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.

4. 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, General design of Nervous System-CNS- its function, Synapes, Receptors, Types of Sensation. EEG.

5. Excretory System:Structure of Kidney, Formation of Urine, Concentration and Dilution of Urine, Renal Function Tests, Artificial Kidneys, Dialysis.

6. Special Senses:Vision: Eye as a camera, Mechanism of accomodation, Visual accuity, Ophthalmoscope, Colour vision, Perimetry.
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:

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.
8. Van Wynsherge.D, Noback, C.R and Caroia R., 'Human Anatomy and Physiology', (1995).

(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 Credits: 3
Exam scheme: Paper- 100 marks

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.

4. 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.
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 :

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.)

(5061204-B) Rehabilitation Engineering

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

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

2. 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)

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

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)

(5061205-A) Bio-imaging Modality

Teaching scheme: 3 lectures/week Credits: 3
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:
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.

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, 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

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:
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,.

Text/Reference Books:

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)

(5061205-B) Biophotonics

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

A . 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,

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

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

(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.)

(6061203)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

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.