Autonomous Program Structure of
M.Tech. Instrumentation and Control Engineering
(Biomedical Instrumentation)

First Semester M.Tech. Instrumentation and Control (Biomedical Instrumentation)											
Course Code	**Course Title**	**Teaching Scheme**			**Examination Scheme**					**Marks**	**Credit**
		Hours/Week			**In sem**		End Sem	Oral	Practical		
		Lecture	Tutorial	Practical	CA*	T1 + T2					
INBI 1101	**Advanced Mathematics**	3	1	0	25	50	50	0	0	125	4
INBI 1102	**Transducer Design**	3	0	0	0	50	50	0	0	100	3
INBI 1103	**Anatomy and Physiology**	3	0	0	0	50	50	0	0	100	3
INBI 1104	**Research Methodology**	3	1	0	25	50	50	0	0	125	4
PEINBI 1101	**Elective I**	3	0	0	0	50	50	0	0	100	3
INBI 1105	**Transducer Design Lab**	0	0	2	25	0	0	0	0	25	1
INBI 1106	**Anatomy and Physiology Lab**	0	0	2	0	0	0	25	0	25	1
INBI 1107	**Elective I Lab**	0	0	2	0	0	0	0	25	25	1
Total		**15**	**2**	**6**	**325**		**250**	**25**	**25**	**625**	**20**
Grand Total		**23**				**625**					**20**

CA* : Continuous Assessment

Elective I: PEINBI 1101

A) Bio-signal Processing
B) Fiber Optics and Laser Technology
C) Control Systems

Second Semester M.Tech. Instrumentation and Control (Biomedical Instrumentation)										
Course Code	Course Title	Teaching Scheme Hours/Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In sem	End Sem	Oral	Practical		
INBI 1201	**Advanced Electronic Instrumentation**	3	0	0	50	50	0	0	100	3
INBI 1202	**Advanced Embedded Systems**	3	0	0	50	50	0	0	100	3
INBI 1203	**Engineering in Medicine**	3	0	0	50	50	0	0	100	3
PEINBI 1202	**Elective II**	3	0	0	50	50	0	0	100	3
INBI 1204	**Advanced Embedded Systems Lab**	0	0	2	0	0	0	25	25	1
INBI 1205	**Engineering in Medicine Lab**	0	0	2	0	0	25	0	25	1
INBI 1206	**Elective II Lab**	0	0	2	25	0	0	0	25	1
INBI 1207	**Seminar**	0	2	0	0	0	50	0	50	2
AC1201	**Non-Credit Course***	0	0	2	0	0	0	0	0	No Credit
Total		**12**	**2**	**8**	**225**	**200**	**75**	**25**	**525**	**17**
Grand Total		**22**			**525**					**17**

Elective II: PEINBI 1202

- **A) Bio-MEMS**
- **B) Advanced Digital Signal Processing**
- **C) Physiological Modeling**

Non-Credit Course*: AC1201

- **A) Soft Skills and Business Communication**
- **B) Entrepreneurship Development**

Third Semester M.Tech. Instrumentation and Control (Biomedical Instrumentation)											
Course Code	Course Title	Teaching Scheme Hours/Week			Examination Scheme In sem					Marks	Credit
		Lecture	Tutorial	Practical	CA	T1 + T2	End Sem	Oral	Practical		
INBI 2101	**Medical Imaging and Image Processing**	3	0	0	0	50	50	0	0	100	3
HSEL 2101	**Elective III**	3	1	0	25	50	50	0	0	125	4
OE 2101	**Elective IV**	3	0	0	0	50	50	0	0	100	3
INBI 2102	**Project Phase I**	0	0	18	0	50	0	50	0	100	9
Total		**9**	**1**	**18**	**225**		**150**	**50**	**0**	**425**	**19**
Grand Total		**28**				**425**					**19**

Elective III: HSEL2101

- **A) Environmental Studies**
- **B) Economics for Engineers**
- **C) Fundamentals of Disaster Management**

Elective IV: OE2101

- **A) Clinical Engineering**
- **B) Rehabilitation Engineering**
- **C) Bioinformatics**

Fourth Semester M.Tech. Instrumentation and Control (Biomedical Instrumentation)										
Course Code	Course Title	Teaching Scheme Hours/Week			Examination Scheme				Marks	Credit
		Lecture	Tutorial	Practical	In sem	End Sem	Oral	Practical		
INBI 2201	**Project Phase II**	0	0	28	150	0	100	0	250	14
Total		**0**	**0**	**0**	**150**	**0**	**100**	**0**	250	14
Grand Total		**28**			**250**				**250**	**14**

INBI 1101 Advanced Mathematics

Teaching Scheme:
Lectures: 3Hrs/Week
Tutorial: 1 Hr/Week

Examination Scheme:
In-Semester: **75** Marks
End-Semester: **50** Marks
Credits: 4

Course Objectives:

1. To recall and remember basics of probability, vectors, statistics and numerical methods.
2. To understand the concepts of basic mathematical methods for probability, vectors, statistics and numerical methods.
3. To apply these method to solve problems.
4. To analyze engineering problems and evaluate.
5. To solve and evaluate the problems using probability, vectors, statistics and numerical methods.

Course Outcomes:

1. Students will be able to remember terminologies and formulae in probability, vectors, statistics and numerical methods.
2. Students will be able to understand and interpret the concepts of probability, vector spaces, statistics and numerical methods.
3. Students will be able to compare and analyze the methods in probability, vector spaces, statistics and numerical methods.
4. Students will be able to predict and evaluate the problems in probability, vector spaces, statistics and numerical methods.

Unit – I: Numerical method for algebraic and differential equations: (06)
Least square method, Gauss-Jordan method, Gauss-Seidal method, Gauss elimination method, Newton-Raphson method, Runge-Kutta methods.

Unit – II: Basic concept of Probability: (06)
Random experiments, sample spaces, axioms of probability, conditional probability, Bayes theorem.

Unit–III: Probability distributions: (07)
Probability distribution function, probability density function, Binomial, Normal, Poisson and uniform distribution

Unit – IV: Mathematical expectations: (07)
Mean variance, standard deviation, moments, covariance and correlation.

Unit – V: Vector Spaces and Transformation: (07)
Vector spaces, subspace and linear dependence, concept of basis, representation, norms of vectors and orthonormalization, linear transformations, concept of symmetry, inner products.

Unit – VI: Orthogonal and Unitary Transformation: (07)
Orthogonal projections, products of projections, orthogonal direct sums, Unitary and orthogonal transformations, closed subspaces and the projection theorem for Hilbert spaces.

Reference Books:

1. Chen C. T., **'Linear Systems: Theory and Design',** *Oxford University Press New York,* (1999)
2. Charles W. Curtis, **'Linear Algebra: An Introductory Approach',** *springer(India)Pvt . Ltd,* (2004)
3. 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. Raja Raman 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)*

INBI 1102 Transducer Design

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:

1. To understand basic principles of sensing various bio signals.
2. To select appropriate sensor/transducer for typical application.
3. To design transducer scheme for given parameter with specifications.
4. To develop mathematical background of sensor design.

Course Outcomes:

1. Ability to select and suggest transducers for various body parameters.
2. Ability to design transducers and signal conditioning for given range and application.
3. Ability to identify, formulate and solve a problem related to Bio signal measurements.
4. Demonstrate an ability to use appropriately and safely the techniques, sensors, and selected modern engineering tools necessary for bio engineering practice

Unit–I: Review of Fundamentals of Transducers for Measurement of: (08)
Physical parameters like pressures, Flow, temperature. Chemical parameters like pH, conductivity. Proximity sensors, Pathological parameters, Detection of alpha, beta and gamma radiation

Unit – II: Review of Signal Conditioners for: (06)
Resistive, Inductive, Capacitive, Piezo Electric and Optical Transducers

Unit – III: Design of Electromechanical Transducers for: (05)
Force, Pressure, Stress, Vibration using Strain-gauge, LVDT , Capacitive Elements, Optical Device, Typical application in each design case such as measurements for Hydraulic and Pneumatic Instruments.

Unit – IV: Case Studies: (06)
Discussion of Selection Criteria Selection of transducers for various biological parameters

Unit – V: Introduction to Advanced Sensors: (05)
Chemical Sensors, Bio sensors, Gas Sensors. Discussions on Nano Sensors and MEMS applications.

Unit – VI: LASER applications (05)
Introduction to LASERS, Applications of Laser in biomedical field

Text Books:

1. D. Patranabis, "**Principle of Industrial Instrumentation**", *Tata McGraw Hill*.(2nd edition), (2002)
2. C.S. Rangan, G.R. Sharma and V.S.V. Mani '**Instrumentation Devices and Systems'**, *Tata Mcgraw- Hill Publishing Company Ltd.* New Delhi.
3. B. C. Nakra and K. K. Choudhari, "**Instrumentation Measurements and Analysis**", *Tata McGraw Hill*

Reference Books:

1. H K P Neubert, '**Instrument Transducers**', *Oxford University Press* (2nd edition), (2003).
2. Bella G Liptak, '**Instrument Engineer Handbook**, Vol 1, 2 and 3 *CRC Press* (3rd edition), (2002).
3. E.O. Doebelin, "**Measurement Systems**", McGraw Hill.
4. J. Wilson, J.F.B. Hawkes, '**Laser Principles and Applications'** , *Prentice-Hall, New York*

INBI 1103 Anatomy and Physiology

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:
1. To study the human anatomy and physiology.
2. To gain knowledge about functioning of body organs.
3. To understand the diseases associated with abnormal working of body organs.
4. Learn measurement of biosignals.

Course Outcomes:
1. Ability to describe various anatomical structures and their functioning.
2. Get the knowledge about biosystems and how they operate the human body.
3. Understand the role and working of electrodes as sensor in biosignal acquisition.
4. Students should be able to use instruments used for cardiac parameter measurement.

Unit – I: Cell Anatomy and Physiology: (04)
Physical Structure of the Cell, Basic Cell Functions, Blood composition, functions of RBC, WBC, platelets, Body Fluids Origin of Biopotentials, Nernst and Goldman and Katz equations, Electrical Activity of Cells, Homeostasis

Unit – II: Cardiovascular and Nervous System: (08)
Heart, anatomy, cardiac cycle, Electrocardiogram, Heart sounds, Blood vessels, anatomy, circulation types, Blood pressure, Regulation of BP.
Nerve cell, classification of nervous system, brain, spinal cord anatomy, hemispheres, CSF meninges, reflexes, PNS, Skeleton, anatomy, Electroencephalogram.
Structure of long bone, formation, growth and repair, joints, classification.

Unit – III: Bio Electrodes: (04)
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.

Unit – IV: Cardiac Instrumentation: (10)
ECG Theory, ECG Electrodes, Electrocardiograph, Different Types of ECG Monitors, Ambulatory monitoring Instruments. Measurement of heart rate; Blood pressure measurement techniques- Direct and Indirect, Plethysmography. Phonocardiography, Blood Flow meters- Electromagnetic, Ultrasound, Indicator dye dilution methods

Unit – IV: Respiratory and Urinary System: (05)
Respiratory system, parts, Mechanics of Respiration, transport of O_2 and CO_2, Respiration regulation, Volume and lung capacities, Hypoxia, Hyperoxia.
Urinary system, Kidney Structure, structure of nephron, regulation of water and electrolyte balance

Unit – VI: Sensory and Digestive System: (06)
Eye, retinal layers, visual path way, ear, physiology, auditory path way, Air and Bone Conduction
Basic anatomy of special senses: Tongue-taste, Nose- smell, Skin-touch – temperature regulation, endocrine glands, hormones, secretions of pituitary, thyroid, parathyroid glands, maintenance of

glucose and calcium, Properties and functions of nervous system with respect to sensory organs.
GI tract, movements, Digestion at various parts of the system, accessory organs of digestion, defecation

Text Books:

1. A.K Jain, '**Text book of Physiology'**, Volume I and II, *Avichal Publishing Company, New Delhi*, (Third edition, 2005)
2. Arthur.C.Guyton, '**Textbook of Medical Physiology',** *Prism Book (P) Ltd*, (1996)
3. Ranganathan, T.S. '**Text Book of Human Anatomy'**, *S.Chand & Co. Ltd., Delhi,* (1996)
4. Leslie Cromwell, Fred J Weibell, Erich A Pfeiffer, '**Biomedical Instrumentation and Measurements'**, *Prentice Hall of India,* (2011)
5. Joseph J. Carr and John M Brown, '**Introduction to Biomedical Equipment Technology'**, *Pearson Education*, (4^{th} edition, 2008)

Reference Books:

1. Elaine.N. Marieb, '**Essential of human Anatomy and Physiology'**, *Pearson Education, New Delhi*, (Eighth edition, 2007)
2. William F.Ganong, '**Review of Medical Physiology'**, *Tata Mc Graw Hill, New Delhi*, (22^{nd} edition, 2010)
3. Elaine.N. Marieb, '**Essential of human Anatomy and Physiology'**, *Pearson Education, New Delhi*, (Eighth edition, 2007)
4. William F.Ganong, '**Review of Medical Physiology'**, *Tata Mc Graw Hill, New Delhi*, (22^{nd} edition, 2010)
5. Joseph Bronzino, '**Biomedical Engineering & Instrumentation'**, *Taylor & Francis,* (3^{rd} edition, 2006)

ECSP1104 Research Methodology

Teaching Scheme:
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week

Examination Scheme:
In-Semester: **75** Marks
End-Semester: **50** Marks
Credits: 4

Course Objectives:

1. To understand basic concepts of research and research methodology
2. To understand principles behind Research problem formulation
3. To study Instrumentation schemes for Data collection
4. To understand Statistical methods for Data Analysis
5. To prepare a research/ project proposal

Course Outcomes:

1. Formulate Research Problems
2. Decide Instrumentation schemes for Data collection
3. Apply Statistical methods for Data Analysis
4. Write research proposals
5. Write and present Technical Papers

Unit – I: Research Problem **(12)**

Research and research problem, sources of research problem, criteria / Characteristics of a good research problem, Literature Review, Scope and objectives of research problem. Hypothesis its importance and construction, Constructing research instrument, Selecting a sample.

Unit – II: Applied statistics **(12)**

Regression analysis, Parameter estimation, Design and analysis of experiments, Multivariate statistics, Principal Component Analysis. Moments and response curve methods, Support vector machines, Uncertainty analysis

Unit – III: Instrumentation schemes **(06)**

Static and dynamic characteristics of instruments used in experimental set up, Basic electrical measurements and sensing devices, flow measurement, Linear scaling for receiver and fidelity of instrument, Data acquisition and processing.

Unit – IV: Research Proposal **(06)**

Developing a Research Proposal and writing a research report. Format of research proposal, Individual research proposal, Institutional proposal, Report writing, Technical Paper writing.

Reference Books:

1. S. Melville, W. Goddard, **'Research Methodology: An introduction for Science & Engineering students'**, *Juta and Company* (1996)
2. R. Kumar, **'Research Methodology: A Step by Step Guide for Beginners'**, *Pearson Education* (2nd Edition), (2005)
3. Dr. C. R. Kothari, **'Research Methodology: Methods and Techniques',** *New Age Publication*, (2nd edition**),** (2010)
4. R. Panneerselvam, **'Research Methodology'**, *PHI Learning* (2nd edition**),** (2014)
5. S. Gupta, **'Research Methodology and Statistical Techniques'**, *Deep and Deep* (2005)
6. N.J. Rajagopalan, **'Research Methodology'**, *Depiti Civil* (Rev. Edition),(1994)
7. D. Buchala, W. Mclachlan, **'Applied Electronic Instrumentation and Measurement'**, *PHI*, (1992)
8. J.P. Holman, **'Experimental Methods for Engineers'**, *McGraw Hill* (7th Edition), (2001)

PEINBI 1101 A) Bio-Signal Processing

Teaching Scheme: **Examination Scheme:**
Lectures: 3 Hrs/Week In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:
1. To learn the frequency domain characteristics of biomedical signals and systems.
2. To design digital filtering techniques to biomedical signals.
3. To design adaptive filtering algorithms to biomedical signals.
4. To design multirate filters to biomedical signals.

Course Outcomes:
1. To compute the response of discrete-time systems to various biomedical signals.
2. To evaluate and analyse the frequency domain characteristics of various biomedical signals.
3. To implement and apply digital FIR and IIR filtering techniques to remove noise in biomedical signals.
4. To implement and apply adaptive and multirate filtering algorithms in biomedical systems.

(06)

Unit – I: Introduction to biomedical signals and systems
Biomedical signals: origin or source, types and characteristics. Biomedical signal conversion: Sampling, signal conversion systems, sampling requirements for biomedical signals. ECG, EEG, EMG, etc. signal characteristics, representation in discrete-time domain. Biomedical signal processing systems: properties, representation and response of systems.

Unit – II: Frequency analysis of biomedical signals **(06)**
Frequency response analysis of biomedical signals, Fourier Transform, Discrete Fourier Transform (DFT), DFT properties, circular convolution, Fast Fourier Transform (FFT) algorithms.

Unit – III: Digital filtering in biomedical signals **(06)**
Digital filters, elements of digital filter, types of digital filters, linear filtering of biomedical signals, pole-zero analysis, characteristics and realizations of finite impulse response (FIR) and Infinite impulse response (IIR) filters, FIR filter design methods, window techniques, frequency sampling. Smoothening or moving average filters for per-processing of biomedical signals. Applications of FIR filters to bio-signals, removal of noise, motion artifacts from ECG signal, and removal of baseline drift in ECG using different FIR filters.

Unit – IV: IIR filters for biomedical signals **(06)**
Conversion of analog filters to digital filters, impulse invariance, bilinear transformation methods, IIR filter design methods, Butterworth approximation, Chebyshev approximation, Applications of IIR filters to bio-signals, removal of high frequency noise and periodic events using different IIR filters.

Unit – V: Adaptive filters **(06)**
Noise Canceler model in biomedical signals, Adaptive filtering algorithms, least mean square (LMS), Recursive least square (RLS) algorithm, applications of adaptive filtering: Maternal ECG in fetal ECG, Cardiogenic artifacts, detection of ventrycular fibrillation and tachycardia, etc.

Unit – VI: Multirate signal processing **(06)**

Decimation, interpolation, sampling rate conversion by a rational factor, implementation, polyphase structures, applications of multirate filtering in biomedical field, subband coding of speech signal, subband coding of ECG signal, subbands of EEG signal.

Text Books:

1. W. J. Tompkins, '**Biomedical digital signal processing**', *Prentice Hall of India,* (1993)

Reference Books:

1. J. G. Proakis , D.G. Manolakis, **'Digital signal processing',** *Prentice Hall of India,* (Fourth edition),(2013)
2. S. K Mitra, **'Digital signal processing',** *Tata Mcgraw-Hill Education*, (Fourth edition),(2013)
3. Oppenheim, Schafer, 'Discrete-time **signal processing',** *Pearson Education* (Third edition), (2010)
4. R. Panneerselvam, **'Research Methodology'**, *PHI Learning* (2nd edition**),** (2014)
5. S. Gupta, **'Research Methodology and Statistical Techniques'**, *Deep and Deep* (2005)
6. N.J. Rajagopalan, **'Research Methodology'**, *Depiti Civil* (Rev. Edition),(1994)
7. D. Buchala, W. Mclachlan, **'Applied Electronic Instrumentation and Measurement'**, *PHI*, (1992)
8. J.P. Holman, **'Experimental Methods for Engineers'**, *McGraw Hill* (7th Edition), (2001)

PEINBI 1101 B) Fiber Optics and Laser Technology

Teaching Scheme: **Examination Scheme:**

Lectures: 3 Hrs/Week In-Semester: **50** Marks

End-Semester: **50** Marks

Credits: 3

Course Objectives:

1. To study the characteristics and properties of optical fiber communication system.
2. To analyse optical fiber sensors for measurements of physical parameters.
3. To study the characteristics of various optical sources and detectors.
4. To study the use of Lasers in medical fields.

Course Outcomes:

1. To design and analyze the optical fiber communication system.
2. To design an optical fiber sensor for measurement of physical parameter.
3. To select optical sources and detectors for an application.
4. To use and analyze Laser based instruments.

Unit – I: Introduction to optical fibers **(06)**

Light waveguide, total internal reflection, numerical aperture, acceptance angle, critical angle, measurements in optical fibers, optical fiber communication system.

Unit – II: Optical fiber losses and components **(06)**

Attenuation, dispersion, refractive index profile, bending losses, polarization, connectors, coupler. Optical fiber amplifiers.

Unit – III: Optical fiber sensors **(06)**

Fiber optics sensing (FOS), advantages and limitations of FOS, Intensity modulations, evanescent field, Use of fiber fibers for measurements of different parameters such as light intensity, phase, etc to measure temperature, level, pressure, vibration.

Unit – IV: Optical sources and detectors **(06)**

LED and LASER, Construction of LED, principle of LASER, types of LASER, PIN and Avalanche photodiodes, selection and design considerations of optical sources and detectors.

Unit – V: Medical applications of Lasers field **(06)**

Endoscope, ophthalmic surgery, other surgical applications, LASER based flow cytometry.

Unit – VI: Laser applications **(06)**

Holography, measurement of stain, stress, vibration, LASER gyroscope, LASER Doppler velocimetry, Laser interferometers.

Reference Books:

1. J. Wilson and J. Hawles, **'Optoelectronics: an introduction',** *Prentice Hall,* (Third edition),(1998)
2. S. Donati, **'Electro-optical Instrumentation',** Pearson Education, (2005)
3. J. Dakin and B. Culshaw '**Optical Fiber Sensors: Principles and Components'**, Artech House Publisher**,** (1988)
4. J. M. Senior, **'Optical fiber communication'**, Pearson Education, (Third edition) (2005)

PEINBI 1101 C) Control Systems

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:
1. Understand the basic concepts of control system design.
2. Learn the designing and various control schemes for various types of systems.
3. To learn the design of control system in discreet time domain.
4. To understand the design and validation of controller using modern control theory.

Course Outcomes:
1. Design a controller based on user requirement specifications.
2. Analyze and validate the design.
3. Analyze the system in time and frequency domain.
4. Analyze and validate controller tuning based on modern control theory.

Unit – I: Compensator design concepts in continuous time control systems **(08)**
Design of compensators: Lead Compensator, Lag compensator and Lag-Lead compensator using root locus and Bode plot.

Unit – II: Compensator Design concepts in discrete time **(06)**
Review of discrete time systems, Design of compensators: Lead Compensator, Lag compensator and Lag-Lead compensator using root locus and Bode plot.

Unit – III: Controller Design **(06)**
Direct controller synthesis, Internal model controller design, Concept of multivariable systems, Concepts of Decoupler and its design.

Unit-IV: Design concepts in state space **(06)**
Basics of state space, concept of controllability and observability, 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.

Unit – V: Controller Design in discrete time **(06)**
Pole placement via state variable feedback, State observer theory, design of full order state observer, design of optimal state regulator.

Unit – VI: Introduction to Advance control systems **(06)**
Introduction to Model predictive controller, Concepts of robust control, Fuzzy logic based control design.

Text Books: author(s), **'Title',** *Publisher in italics* (edition in bracket), (Year in bracket)
1. Ogata K., 'Discrete Time Control Systems', (Prentice Hall of India, Delhi) (2004).
2. Ogata K., 'Modern Control Engineering', (Prentice Hall Of India Pvt. ltd.) (1992).

Reference Books:
1. Goodwin , Graebe S F & Salgado M E, 'Control System Design', (Prentice hall of India Delhi)
2. Friedland B., 'Advanced Control System Design' , (New Jercy. Prentice Hall Inc) (1998).
3. M.Gopal, 'Digital Control and State Variable Method', (Tata-McGraw Hill, Delhi) (1997).
4. Constantine H. and Gary B. Lamont, 'Digital Control Systems', Second Edition, (McGraw-hill)

INBI 1105 Transducer Design Laboratory

Teaching Scheme: **Examination Scheme:**
Practicals: 2 Hrs/Week In-Semester: 2**5** Marks
Credits: 1

List of Practical Assignments:

1. To study the working and characteristics of transducers typically used in biomedical field.
2. Design of sensors to acquire various parameters. For eg: Clinical thermometer, breath sensor, etc.
3. Characterization of the designed sensors
4. Design and develop the signal conditioning for various biomedical applications. For eg: Load cell, spirometer
5. Assignment based on Survey in hospitals and pathology laboratories
6. Various assignments based on Transducer Design

INBI 1106 Anatomy and Physiology Laboratory

Teaching Scheme: **Examination Scheme:**

Practical: 2 Hrs/Week Oral: **25** Marks

Credits: 1

List of Experiments:

1. Organ system overview- Locate, Identify, name the parts and describe functions of the following using models / figures.
    - Skin
    - Heart, blood vessels
    - Urinary system
    - Respiratory system
    - Digestive system
    - Bones joints and their types
    - Muscle and their types
    - Nerve cell
    - Endocrine glands
2. ECG Recording using Power Lab and ECG machine
3. BP measurement using fully automatic machine and sphygmomanometer and Power lab
4. Pulse rate and Pulse transit time Measurement using Power Lab
5. Heart Sound Recording using Power lab- Correlation of ECG and PCG
6. Measurement of vital capacity and respiratory rate using Power lab spirometer
7. Visit to human anatomy and physiology laboratory in the medical college

INBI 1107 A) Bio-Signal Processing Laboratory

Teaching Scheme: **Examination Scheme:**
Practical: 02 Hrs/Week Practical examination: **25** Marks
Credits: 1

Students are expected to perform minimum 8 experiments in MATLAB. The experimentation should be conducted on various 1-D/2-D biomedical signals:

List of Experiments :

1. Implementation of linear filtering of any biosignals.
2. Correlations of the given biomedical signals.
3. Frequency analysis of ECG signals using DTFT.
4. Frequency analysis of ECG signals using DFT.
5. Implementation of FFT algorithms for the analysis of biomedical signals.
6. Designing a FIR low pass filter for noise removal in ECG/EEG/EMG signals.
7. Designing a Butterworth IIR low pass filter for noise removal in ECG/EEG/EMG signals.
8. Designing a Chebyshev IIR low pass filter for noise removal in ECG/EEG/EMG signals.
9. Design of adaptive filtering algorithms.
10. Subband coding of speech signals.
11. Real-time implementation of FIR filter

INBI 1107 B) Fiber Optics and Laser Technology Laboratory

Teaching Scheme: **Examination Scheme:**

Practical: 02 hrs/week Practical examination: **25** Marks

Credits: 1

List of Experiments

1. Measurement of the various losses in the given optical fiber.
2. Numerical aperture measurement of given optical fiber.
3. Measurement of characteristics of photo detectors using optical power meter.
4. To study characteristics (optical return loss, attenuation, faults) of optical time domain reflect meter (OTDR).
5. Design of an optical fiber sensor and its response analysis (e.g. displacement, vibration).
6. Electrical modulation of laser intensity, frequency modulation, pulse-width modulation.
7. Measurement of beam width, coherence length, divergence angle and beam profile of a laser.
8. 8. Measurement of polarization of Laser output (experiment on polarized laser light).

INBI 1107 C) Control Systems Laboratory

Teaching Scheme: **Examination Scheme:**

Practical: 2 Hrs/ Week Practical examination: **25** Marks

Credits: 1

Students are expected to perform any 8 experiments

1. Study of magnitude and phase characteristics of lead, lag and lag□lead compensator.
2. Design a lead / lag compensator for getting desired specifications by root locus approach.
3. Design a lead / lag compensator for getting desired specifications by Bode plot approach.
4. Design of lead/lag in discrete time domain
5. Design a controller using direct controller synthesis for getting specified closed loop Response.
6. Design of decoupler for two input two output system
7. Conversion of transfer function model to state space and vice□versa.
8. Check for complete state controllability and complete state observability of a given system.
9. Design a state feedback controller through pole placement.
10. Design full order state observer using principle of duality between state feedback gain matrix K and observer gain matrix Ke.
11. Study of Model predictive control

INBI 1201 Advanced Electronic Instrumentation

Teaching Scheme: **Examination Scheme:**

Lectures: 3 Hrs/Week In-Semester: **50** Marks

End-Semester: **50** Marks

Credits: 3

Course Objectives:

1. To be able to analyze and justify the requirement of Instrument and Systems.
2. To design various electronic circuits and measurement systems.
3. To study noise identification and appropriate elimination methods related to instrument.
4. Understand the use of advanced electronic instruments.

Course Outcomes:

1. Ability to analyze the signals using electronic analyzers
2. Design amplifier circuits for biosignals
3. Students would be able to select, design appropriate enclosure, cables, PCB.
4. The capability to estimate, analyze, improve the reliability of instrument and system.

(07)

Unit – I: Study of Electronic Instruments:

Universal counter & its modes, Measurement errors in counters, Applications of counter, True RMS meter, Automatic Test Equipment, IC based bio-signal amplifier (INA 333, INA 128), isolation amplifier

Unit – II: Electronic Analyzers: **(06)**

Distortion meter, Wave analyzer, Spectrum analyzer, Heterodyne spectrum analyzer, frequency synthesizers

Unit – III: PCB Design Concepts: **(06)**

PCB layout and design, Types of PCB, Analog and digital PCB design guidelines

Unit – IV: Grounding and Shielding: **(06)**

Grounding techniques, Shielding techniques: near field, far field, absorption loss and reflection loss, ESD and protection against ESD

Unit – V: Electromagnetic Compatibility: **(06)**

EMI/EMC, Noise, noise coupling, interference, cabling, grounding, ground loops.

Unit – VI: ADC and DAC Design: **(05)**

Review of Successive approximation, flash and dual slope ADC, Quantization, ADC and DAC Specifications, Selection of ADC and DAC parameters for various applications

Text Books:

1. Clyde F. Coombs, '**Electronic Instrument Handbook**', *Tata McGraw Hill*, (Third Edition)(2000)
2. Helfrick A.D, Cooper W.D, **' Modern Electronic Instrumentation and Measurement Techniques'**, *Prentice Hall of India, 2005*
3. David A. Bell, '**Electrical and Electronic Measurements and Instrumentation'**
4. Henry W Ott, John , '**Electromagnetic Compatibility Engineering'**, *Wiley and Sons Inc. Publication*
5. W. C. Bosshart, '**PCB Design and Technology',** *Tata McGraw Hill, 1997*

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Reference Books:

1. Oliver Cage, '**Electronic Measurements and Instrumentation**', *McGraw Hill,* (First Edition) *(1975)*
2. J. J. Carr, '**Electronic Instrumentation**', *Pearson Education,* (Third Edition) *(*2003).
3. Bouwens A.J, '**Digital Instrumentation**', *Tata McGraw Hill,* 1983

INBI 1202 Advanced Embedded Systems

Teaching scheme:
Lectures: 3Hrs/ Week

Examination Scheme:
In Semester: **50** Marks
End Semester: **50** Marks
Credits:3

Course Objectives:

1. To understand communication protocols used in industrial environment.
2. Understanding of the basic principles of Embedded Processor/Controller based design and development.
3. To Develop ability to program the ARM Processor and PIC microcontroller.
4. To design and build functional prototype for real world applications.

Course Outcomes:

1. Ability to design and build a functional prototype for real world applications.
2. To encourage the students to have a better understanding on state-of-art embedded technologies like system-on-chip design and reconfigurable embedded designs, their potential applications and their market views.
3. Ability to work in a group to design systems, solve problems and its applicability for the society.
4. Ability to transfer data by establishing communication using appropriate protocol in two systems

UNIT - I: Introduction to Communication Protocols: (04)
OSI reference model, Industry Network, Recent networks, Communication basics, Network Classification, Device Networks, Control Networks, Enterprise Networking, Network selection.

UNIT-II: Industry Open and proprietary Protocols: (08)
Proprietary and open networks: Network Architectures, Building blocks, Industry open protocols (RS232C, RS- 422, RS-485), Ethernet, Modbus, Modbus Plus, Data Highway Plus. Fieldbus: Fieldbus Trends, Hardware selection, Fieldbus design, Fieldbus advantages and limitations. Foundation Fieldbus & Profibus: Introduction, Design, Calibration

UNIT-III: HART and Wireless Protocols: (03)
HART: Introduction, Design. Introduction to wireless Protocols: WPAN, Wi-Fi, Bluetooth, ZigBee, Z-wave.

UNIT-IV: ARM Processor (07)
tures, ARM Architecture Overview, ARMv7 Architecture, Programmer's Model, Memory Systems, Floating Point Extensions, ARM System Design, Software Development Tools

UNIT-V: PIC Micro-controller PIC18FXX (07)
Features, Architecture, Memory, on chip peripherals, Instructions, Programming, Applications and System Development

UNIT-VI: Introduction to Raspberry Pi (07)
Hardware aspects, Board details, Overview of available hardware resources, Operating systems available, Raspberry Pi Configuration, Programming the Pi, Hardware Interfacing (GPIO,

LED, Buzzer, Switch interfacing, Sensors Interfacing)

Reference Books:

1. B.G. Liptak**, 'Process Software and Digital Networks'**:, *CRC Press ISA- The Instrumentation, Systems, and Automation Society* (3rd edition),(2002)
2. Romilly Bowden, **'HART Communications Protocol'**, *Fisher-Rosemount*.
3. User Manuals of Foundation Fieldbus, Profibus, Modbus, Ethernet, Device Net, Controlnet
4. Dogan Ibrahim, **'Advanced PIC Microcontroller Projects in C: From USB to RTOS with the PIC 18FXX Series**'
5. ARMv7 Architecture Reference Manual
6. Raspberry Pi Reference Manual

INBI 1203 Engineering in Medicine

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:
1. To study measurement of various physiological parameters.
2. To introduce life saving devices.
3. Learn safety aspects of medical instruments.
4. To study the signal conditioning techniques for various biosignals.

Course Outcomes:
1. Ability to use biosignal recording instruments.
2. Design and develop signal conditioning for different biosignals.
3. Know the instruments used in pathology lab.
4. Get knowledge of advanced instruments used in hospitals.

Unit – I: Life Saving Devices: **(06)**
Cardiac pacemakers: external and Implantable pacemaker, Cardiac defibrillator: DC defibrillator, implantable defibrillator and defibrillator analyzer, Heart Lung Machine
Operating Room Instrumentation: Elecrosurgical unit(ESU), Anesthesia Machine

Unit – II: Nervous system and ICU Instrumentation: **(05)**
EEG -10-20 electrode system, Lead Configuration and Recording System
Muscle Contraction Mechanism, Myoelectric voltages, Electromyography
ICU Instrumentation: Multipara meter monitor, Bedside Monitor, Drug Delivery system, Layout design

Unit – III: Clinical Lab Instrumentation: **(06)**
Introduction, medical diagnosis with chemical test, Spectrophotometer, Colorimeter - Auto analyzers, clinical flame photometer, Blood pH measurement, Blood $P_{O2,}$ P_{CO2} measurement, Oximetry, Principle, Invitro and Invivo oximetry
Nomogram, Blood Cell Counters- Coulter, dark field method, Flow Cytometry

Unit – IV: Sensory Instrumentation: **(06)**
Ear: Hearing loss, Sound conduction system, Basic audiometer, Pure tone audiometer, Bekesy Audiometer system, Evoked response audiometer, Hearing aids.
Vision: Visual acuity, Errors in vision, slit lamp, Tonometer, Ophthalmoscope, Perimeter.

Unit – V: Respiratory and Kidney Instrumentation: **(06)**
Spirometers, Airflow measurement, oxygenators- bubble type, membrane type, Ventilator
Dialysis-basic principle of dialysis, Dialyzers: different types of dialyzers, Peritoneal dialysis, Hemodialysis
Lithotripsy

Unit – VI: Bio Signal Conditioning Techniques: **(07)**
Amplifiers – Differential amplifiers, Instrumentation amplifier, Chopper amplifiers, Isolation amplifier. Transient Protection, Interference reduction, movement artifact circuits, Active filters, Rate Measurements, Averaging and Integrating Circuits

Patient Safety: Electric shock hazards, leakage currents, electrical safety analyzer, testing of biomedical equipments, safety codes

Text Books:

1. Leslie Cromwell, Fred J Weibell, Erich A Pfeiffer, '**Biomedical Instrumentation and Measurements'**, Prentice Hall of India, (2011)
2. Joseph J. Carr and John M Brown, '**Introduction to Biomedical Equipment Technology'**, *Pearson Education*, (4 th edition, 2008)
3. John G. Webster, '**Medical Instrumentation Application and Design**', *Wiley,* (3 edition ,1997)
4. R. S. Khandpur '**Handbook of Bio-Medical Instrumentation'**, *Tata McGraw Hill*, (2nd Edition, 2003)
5. Ronald Pitts Crick, Pang Khaw, 'Text book of Clinical Ophthalmology', *World Scientific publication,* (2nd edition)

Reference Books:

1. Geddes L.A and Baker L.E, '**Principles of Applied Biomedical Instrumentation**', *Wiley-Interscience,* (3 edition, 1989)
2. Joseph Bronzino, '**Biomedical Engineering & Instrumentation'**, *Taylor & Francis,* (3rd edition,2006)

PEINBI 1202 A) Bio-MEMS

Teaching Scheme:
Lectures:3 Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits:3

Course Objectives:
1. To study design and applications of micro and nano sensors
2. To Study Micro systems used in Biomedical field
3. To study fabrication process
4. To study MEMS material

Course Outcomes:
1. Ability to select and design the micro sensors for various applications
2. To be able to design and implement sensor technology using software and fabrication and Hardware
3. Students get knowledge of fabrication
4. Students get knowledge of material.

Unit – I: Introduction to BioMEMS and Microsystems technology (08)
Biochips/ biosensors and introduction to device fabrication, Introduction to Cell biology.DNA & Protein chemistry, Microfluidics. Biochip Sensors & detection methods. Potential of Micro-fluidics and introductory continuum mechanics at small scales, Microarrays and Lab-on-chip devices, Introduction to MEMS Design

Unit – II: Materials for Mems and Microsystems (07)
Introduction- Substrates and Wafers, Active Substrate Materials – silicon as a substrate Material, Silicon Compounds, Polymers photoresists and Packaging Materials

Unit – III: Microsystems Fabrication Processes (08)
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)

Unit – IV: Micromachining: (07)
Bulk Micromachining, Surface Micromachining, High Aspect- Ratio Processes (LIGA), Polymer Micro/Nano Fabrication

Unit – V: Micro Total Analysis Systems (µTAS) (08)
Components, Micro Fluidics and Fluid control components (channels, pumps, valves),
µ-TAS: sample handling – (Micro actuators examples -micro valves, micro pumps, micro motors, Micro mixers, Micro activation methods), µ-TAS: separation components-TAS: detection

Unit – VI: Micro/ Nano Biosensors (07)

Text Books:

1. Marc Madou, **'Fundamentals of Micro fabrication',** *CRC Press*, (1997).

Reference Books:

1. **'Micro machined Transducers Sourcebook ',** *WCB McGraw-Hill, Boston*, (1998).

2. Steven S. Saliterman, **'Fundamentals of BioMEMS and Medical Micro devices ',** *SPIE Press Monograph Vol. PM153 by Wiley Interscience*
3. A. Manz and H. Becker, Eds. **'Microsystem Technology in Chemistry and Life Sciences',** *Springer- Verlag, New York*, (1999)
4. Stephen D. Senturia, **'Microsystem Design',** by, *Kluwer Academic Publishers*,(2001).
5. M.-H. Bao, **'Micromechanical Transducers: Pressure sensors, accelerometers, and gyroscopes',** *Elsevier, New York*,(2000.)

PEINBI 1202 B) Advanced Digital Signal Processing

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
In-Semester: **50**Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:

1. To learn the basic concepts and properties of multi-rate DSP
2. To learn the basic concepts and properties of wavelet transform
3. To learn the characteristics of signal modelling
4. To study the linear prediction algorithms, power spectrum estimation and adaptive filters

Course Outcomes:

1. To understand the concepts of multi-rate DSP and wavelets
2. To evaluate and analyse the random process
3. To design and implement prediction, power estimation and adaptive filters

Unit – I: Stochastic Processes **(06)**

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

Unit – II: Linear Prediction **(06)**

Innovations representation of a stationary random process, forward and backward linear prediction, solutions of the normal equations. Properties of linear prediction-error filters, AR and ARMA lattice filters, Wiener filters and predictions, Applications of linear predictions to biomedical signals.

Unit – III: Spectral Estimation **(06)**

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.

Unit – IV: Time-frequency analysis **(04)**

Time frequency analysis, the need for time frequency analysis, Time frequency distribution, Short time Fourier Transform, introduction to wavelets.

Unit-V:MRA & CWT: **(07)**

Definition of Multi Resolution Analysis (MRA), Haar Basis, Construction of General Orthonormal MRA, Continuous Time MRA, Scaling Function and Wavelet Functions (Daubechies Coiflet, Mexican Hat, Sinc, Gaussian), Tiling of Time – Scale Plane for CWT, CWT as a correlation, CWT as an operator, Inverse CWT.

Unit – VI:DWT: **(07)**

Wavelets derived from iterated filter banks, Wavelet Filters – Inverse DWT, Choice of Wavelet Function Coefficients, Derivations of Daubechies Wavelets, Mallat's Algorithm for DWT, Decomposition and Reconstruction filters, examples of orthogonal basis generating wavelets, filter bank implementation of two dimensional wavelet transform. Applications of Wavelet Transform to biomedical signals.

Text Books:

1. J. Proakis , Charles M. Rader, Fuyun Ling, Christopher L. Nikias, **'Advanced Digital Signal Processing'**, *Macmillan Coll Div,* (1992)
2. Leon Cohen, '**Time Frequency Analysis',** *Prentice Hall*, (1995)
3. K P Soman and K I Ramachandran, **'Insight into wavelets: From theory to Practice',** *Prentice Hall of India.*

Reference Books:

1. Glenn Zelniker, Fred J. Taylor, **'Advanced Digital Signal Processing'**, *CRC Press.* (1994)
2. A.V.Oppenheim, R.W.Schafer, **'Discrete time Signal Processing'**, *Prentice Hall,* (1992)
3. P.P. Vaidyanathan, **'Multirate systems and Filter banks'**, *Prentice Hall,* (1993)
4. J C Goswamy, A K Chan, **'Fundamentals of Wavelets: Thory, Algorithms and Applications'**
5. G Strang, T Q Nguyen, **'Wavelets and filter banks'**, *Wellesley Cambridge Press*, (1998).
6. Steven M . Kay , **'Modern Spectrum Estimation'**, *Prentice Hall, (*1988)

PEINBI 1202 C) Physiological Modeling

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:
1. To study various modeling approaches.
2. To study and implement the various properties of cell membrane.
3. To learn simulation of models using MATLAB tools.
4. To design a model, simulate and analyze any kind of physiological systems.

Course Outcomes:
1. Ability to design and develop a suitable model for the given specifications.
2. Simulation of models through Matlab.
3. Analysis of developed models.

Unit – I: Approaches to Modeling: (08)
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

Unit – II: Properties of Cell: (08)
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

Unit – III: Equivalent Circuit Model: (06)
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.

Unit – IV: Physiological Modeling: (07)
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

Unit – V: Linearized Model: (06)
Linearized model of the immune response: Germ, Plasma cell, Antibody, system equation and stability criteria.

Text Books:

1. Endarle, Blanchard & Bronzino, '**Introduction to Biomedical Engg**.' , *Academic press*, (2001)
2. Suresh. R. Devasahayam, '**Signals & Systems in Biomedical Engineering'**, *Kluwer Publishers*
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)

Reference Books:

1. L.Stark, '**Neurological Control System'**, *Plenum Press*, (2001)
2. R.B. Stein, '**Nerve and Muscle'**, *Plenum Press,* (1988)

INBI 1204 Advanced Embedded Systems Laboratory

Teaching scheme: **Examination Scheme:**

Practicals: 2Hrs/ Week Practical: **25** Marks

Credit:1

8 Experiments / Practicals are to be performed on any two processors mentioned in the syllabus.

1. MODBUS communication between two systems.
2. Signal Transmission using Zigbee
3. Study of comparison between CISC and RISC processors.
4. Basic Programs: Arithmetic logical operations, Code Conversions using embedded processor.
5. Basic Programs: Counting/Looping, Stack operations using embedded processor.
6. Square wave generation using timer/counter of using embedded processor.
7. Simulation of sine/square/triangular waveform using embedded processor.
8. Interfacing of LCD display to embedded processor.
9. Interfacing of Keyboard to embedded processor.

INBI 1205 Engineering in Medicine Laboratory

Teaching Scheme: **Examination Scheme:**

Lectures: 2 Hrs/Week Oral: **25** Marks

Credits: 1

List of Experiments:

1. To design ECG calibrator.
2. Design of ECG amplifier using op-amp.
3. To design notch filter for line frequency and a band pass filter.
4. To design and develop Heart Rate Meter.
5. EEG Recording using EEG machine.
6. To study and acquire Real time ECG using Bedside Monitor.
7. To design and develop thermistor based flow spirometer / Demo of Turbine spirometer.
8. To perform the hearing test using audiometer.
9. Study of ophthalmic instrument- Visit to Eye Care Clinic.
10. Hospital Visit and report submission- Dialysis Unit and Pathology lab.

INBI 1206 A) Bio-MEMS Laboratory

Teaching Scheme:
Lectures: 2 Hrs/Week

Examination Scheme:
In-Semester: **25** Marks

Credits: 1

List of Experiments:

1) . Design of MEMS Pressure sensor
2) Design of MEMS capacitive Pressure sensor
3) Design of Piezoelectric energy Harvester
4) design of tuning fork
5) Saw gas sensor
6) Thickness shear quartz oscillator
7) Design of Micro Pump
8) Red Blood cell separation

INBI 1206 B) Advanced Digital Signal Processing Laboratory

Teaching Scheme: **Examination Scheme:**

Lectures: 2 Hrs/Week In-Semester: **25** Marks

Credits: 1

List of Experiments:

1. Power spectral analysis of an ECG using parametric methods.
2. Power spectral analysis of an ECG using non-parametric methods.
3. Implementation of linear prediction filtering algorithms.
4. Frequency analysis of stationary and non-stationary signals using FT.
5. Time frequency analysis of Gaussian Function.
6. Implementation of DWT for 1D signal and verify using the direct MATLAB command.
7. Introduction to Wavelet Toolbox
8. Applications Demo using Wavelet Toolbox

INBI 1206 C) Physiological Modeling Laboratory

Teaching Scheme: **Examination Scheme:**
Lectures: 2 Hrs/Week In-Semester: **25** Marks
Credits: 1

List of Experiments:

1. Introduction to modeling and Simulink.
2. Theoretical assignments based on mathematical modeling for various biosystems.
3. Design and develop SIMULINK model for steady-state analysis of muscle stretch reflex.
4. Design a model to compute frequency response of linearized lung mechanics model using appropriate software.
5. Design a SIMULINK model of simplified and linearized version of Hodgkin-Huxley model.
6. Design a SIMULINK model for cardiovascular system variability.
7. SIMULINK model of simple lung mechanics.
8. Simulation of Hodgkin – Huxley model of nerve membrane.

INBI 1207 SEMINAR

Teaching Scheme: **Examination Scheme:**
Tutorial: 2 Hrs/Week Oral: **50** Marks
Credits:2

Seminar shall be on the topic relevant to latest trends in the field of Instrumentation branch, Preferably on the topic based on the electives selected by 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.

AC1201 A) Soft Skills and Business Communication

Teaching Scheme: **Examination Scheme:**

Practical: 2 Hrs/Week In-Semester: **--**

End-Semester: **--**

Credits: NIL

Course Objectives:

1. To help the students to develop as team member, leader and all round professional in the long run.
2. This course would focus on over all personality development.
3. Have right attitudinal and behavioral aspects, and build the same through activities.
4. Possess right professional and social ethical values.
5. To make student confident in communicating in Business environment.
6. Improve their fluency in English language.

Course Outcomes:

1. To communicate, interact and present his ideas to the other professionals.
2. Understand and aware of importance, role and contents of soft skills through instructions, knowledge acquisition, demonstration and practice.
3. Have right attitudinal and behavioral aspects, and build the same through activities.
4. Possess right professional and social ethical values.
5. The student will overcome apprehension of communicating in professional environment.
6. Language proficiency will enable student present ideas, applications and reports effectively in oral and written communication.

(03)

Unit – I: Self-Awareness & self-Development

a) Self Assessment, Self Appraisal, SWOT, Goal setting -Personal &career-Self-Assessment, Self-awareness, Perceptions and Attitudes, Positive Attitude, Values and Belief Systems, Self-Esteem, Self appraisal, Personal Goal setting.

b) Career Planning, Personal success factors, Handling failure, Depression and Habit, relating SWOT analysis & goal setting, prioritization.

Unit – II: Communication Skill **(06)**

a) Importance of communication, types, barriers of communication, effective communication.

b) Speaking Skills– Public Speaking, Presentation skills, Group discussion- Importance of speaking effectively, speech process, message, audience, speech style, feedback, conversation and oral skills, fluency and self expression, body language phonetics and spoken English, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques.

c) Listening Skills: Law of nature- you have 2 ears and 1 tongue so listen twice and speak once is the best policy, Empathic listening, and Avoid selective listening.

d) Group Discussion- characteristics, subject knowledge, oral and leadership skills, team management, strategies and individual contribution and consistency.

e) Presentation skills- planning, preparation, organization, delivery.

f) Written Skills– Formal & Informal letter writing, Report writing, Resume writing- Sentence structure, sentence coherence, emphasis. Paragraph writing, Letter writing skills-form and structure, style and tone.

Inquiry letters, Instruction letters, complaint letters, Routine business letters, Sales Letters etc.

Unit – III: Corporate/ Business Etiquettes. (02)

Corporate grooming & dressing, Email & telephone etiquettes, etiquettes in social & office setting- Understand the importance of professional behavior at the workplace, Understand and Implement etiquettes in workplace, presenting oneself with finesse and making others comfortable in a business setting. Importance of first impression, Grooming, Wardrobe, Body language, Meeting etiquettes (targeted at young professionals who are just entering business environment), Introduction to Ethics in engineering and ethical reasoning, rights and responsibilities.

Unit – IV: Interpersonal relationship (03)

Team work, Team effectiveness, Group discussion, Decision making - Team Communication Team, Conflict Resolution, Team Goal Setting, Team Motivation Understanding Team Development, Team Problem Solving, Building the team dynamics. Multicultural team activity

Unit – V: Leadership skills (01)

Leaders' role, responsibilities and skill required- Understanding good Leadership behaviors, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules, Defining Qualities and Strengths of leadership, Determining how well you perceive what's going on around you, interpersonal Skills and Communication Skills, Learning about Commitment and How to Move Things Forward, Making Key Decisions, Handling Your and Other People's Stress, Empowering, Motivating and Inspiring Others, Leading by example, effective feedback

Unit – VI: Other skill (03)

a) Time management-The Time management matrix, apply the Pareto Principle (80/20Rule) to time management issues, to priorities using decision matrices, to beat the most common time wasters, how to plan ahead, how to handle interruptions, to maximize your personal effectiveness, how to say "no" to time wasters, develop your own individual plan of action.

b) Stress management- understanding the stress & its impact, techniques of handling stress

c) Problem solving skill, Confidence building Problem solving skill, Confidence building.

Reference Books:

1. S. Kumar, S. Pushpalata , **'Communication Skills'** , *Oxford University Press.* (1st edition) (2011)
2. K. Mohan, M. Banerji , **'Developing Communication Skill' ,** *McMillan India Ltd.* (1st edition) (2011)
3. S. Sweeney, **'English for Business Communication'** *Cambridge UniversityPress.* (1st edition) (2013)
4. B. K. Mitra, **'Personality Development and Group Discussions',** *Oxford University Press.* (1st edition)
5. S. Napoleon Hill **'Think and Grow Rich'**, *Ebury Publishing*, (1st edition). (1937)

AC1201 B) Entrepreneurship Development

Teaching Scheme: **Examination Scheme:**

Practical: 2 Hrs/Week In-Semester: **--**

End-Semester: **--**

Credits: NIL

Course Objectives:

1. An understanding of the scope of Entrepreneurship Development
2. To make them understand key areas of Business development
3. Understand different sources of finance, project preparation and legal requirements for Business.
4. Understand the significance of Entrepreneurship and economic growth
5. Application of engineering skills in entrepreneurial activities etc.

Course Outcomes:

1. Develop an entrepreneur attitude.
2. Analyze business opportunity and will be ready with business plan
3. Take decisions related to procurement and application of funds.
4. Students are better prepared to become effective team members and can better support their employers as innovators.

(06)

Unit – I: Modern Small Business Enterprises

Role of Small- scale Industries, Concepts and definitions of SSI, Government Policy and Development of the Small-scale sector in India, Growth and performance of small scale Industries in India, Small and Medium Enterprises in other countries, Problems for Small-scale Industries in a free Economy, Institutions supporting small Business Enterprises: Central Level, State Level, Other agencies and Industry Associations.

Unit – II: Entrepreneurship and Emerging areas **(10)**

Importance of Entrepreneurship, Concepts of Entrepreneurship and corporate Entrepreneurship Characteristics of a successful Entrepreneurship, Classification of Entrepreneurship, Myths of Entrepreneurship, Emerging areas in Entrepreneurship: Women Entrepreneurship: Types, Challenges, Opportunities, Achievements,, Problems, Remedial Measures & supporting Institutions and Role Models of Woman Entrepreneurs in India, Self Help Group, Rural Entrepreneurship: meaning, need, Problems, Development, Role of NGO's, Entrepreneurship in agriculture, TRYSEM, Social Entrepreneurship: Genesis & Characteristic, International Entrepreneurship, E-Entrepreneurship: Concept, Purpose and Essence, Profiles of successful Entrepreneurs of each emerging field

Unit – III: Setting Up a Small Business Enterprise **(10)**

Identifying the Business Opportunity, assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, Business opportunities in various sectors Formalities for Setting Up of a Small Business Enterprises Environment Pollution Related Clearances.

Unit - IV: Financial Management in small Business **(10)**

Importance of Financial Management, Accountancy, Preparation of balance sheets and assessment of economic viability, Capital structure, Cost of capital, Sources of Finance, Working

capital Management, Capital Budgeting decisions: Pay-back period, discounted cash flow, internal rate of return and net present value methods. Taxation – Direct, Indirect Taxes.

Unit – V: Production Management in small Business (05)

Production Management, Materials Management, inventory control, Productivity, Break Even Analysis, Total quality management, Environmental Management System.

Unit – VI: Legal Requirements (04)

Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes

Industrial Relations Laws: workman compensation act, Labour Laws, Environment and Pollution Control laws.

Reference Books:

1. P. M. Charantimath, "**Entrepreneurship Development and Small Business Enterprises**",*Pearson Education India* (2nd edition),(2005)
2. V. Desai, "**Dynamics of Entrepreneurial Development and Management**" , *Himalaya Publishing House* (4th edition),(2007)
3. J. Forbat,"**Entrepreneurship** ",*New Age International pvt Limited*(Ist edition),(2008)
4. J. L. Massod, **"Essential of Management"**,*Prentice Hall of India* (4th edition), (1986)
5. M. Lall, S. Sahai, **"Entrepreneurship"** ,*Excel Books* (2nd edition),(2008)
6. N. Baporikar**, " Entrepreneurship Development and Project Management",** *Himalaya Publishing House*(2nd edition),(2013)
7. Gupta, Srinivasan, **"Entrepreneurship Development in India"**, *Sultan Chand & Sons(*new edition),*(2013)*

INBI 2101 Medical Imaging and Image Processing

Teaching Scheme: **Examination Scheme:**
Lectures: 3 Hrs/Week In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:
1. To acquire knowledge about fundamental concepts of imaging.
2. To study principle and working of various medical imaging techniques.
3. To know the applications of various imaging modalities.
4. To learn basic digital image processing techniques like enhancement and segmentation.

Course Outcomes:
1. Understand the working of various imaging techniques
2. Understand the concept of 2D and 3D imaging process.
3. To gain knowledge about the various image enhancement and segmentation techniques.
4. Ability to apply the image processing techniques to medical images for diagnosis.

Unit – I: X-Ray Imaging: **(12)**
Electromagnetic Spectrum, Interactions between Radiation and matters; Fundamentals of acoustic propagation; Interaction between sonic beams and matter;
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. Fluoroscopy and Visual Physiology,
Angiography: Arterial access, Catheters, Contrast media;
Mammography: Soft tissue radiography, Equipments: Target composition, Filtration grids, Photo timers, Image receptors;
Xero radiography; Digital radiography

Unit – II: Computed Tomography **(04)**
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.

Unit – III: Ultrasound Imaging **(06)**
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, Color Doppler flow imaging: CW Doppler imaging device, Pulsed Doppler imaging system, 2-D echo cardiography

Unit – IV: Advances in Imaging **(06)**
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

Unit – V: DIGITAL IMAGE FUNDAMENTALS and ENHANCEMENT (05)

Elements of visual perception, Image formation model, image sampling and quantization, some basic relationships between pixels, matrix and singular value representation of discrete images

Gray level transformation, Histogram processing, enhancement using arithmetic/logic operation, spatial filtering –smoothening and sharpening, filtering in frequency domain-smoothening and sharpening, frequency domain, filters- homomorphic filtering

Unit – VI: IMAGE SEGMENTATION AND FEATURE EXTRACTION (05)

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

Text Books:

1. K. Kirk Shung, Michael B. Smith, Benjamin Tsui, '**Principles of Medical Imaging**', *Academic Press,* (First Edition,1992)
2. Stewart C. Bushong, '**Radiologic science for Technologists**', *Elseveir, (*9th Edition)
3. Gonzalez R.C.; Woods R.E.; Eddins S.L, '**Digital Image Processing with Matlab**', *Tata McGraw-Hill, (*2Nd Edition, 2010)
4. A. K. Jain, '**Fundamentals of Digital Image Processing**', *Prentice Hall of India, (First Edition, 2004)*

Reference Books:

1. Jeffery Papp, '**Quality Management: In the Imaging Sciences**', *Mosby: A Harcourt Health Sciences Company*
2. Christensens, '**Physics of Diagnostic Radiology**', *Lea & Febiger*, U.S., (4th edition, 1990)
3. David J. Dowsett, Patrick A. Kemmy, R. Eugene Jhnston, '**The Physics of Diagnostic Imaging**', *A Hodder Arnold Publication,* (2nd edition)
4. W.J. Meredith & J. B. Massey, '**Fundamental Physics of Radiology**', John Wright & Sons Ltd., (3rd.ed.) (1977)
5. Jole Pierce Jones, '**Acoustic Imaging**', *Plenum Publishing,* Vol 22, (1994)

HSEL 2101 A) Environmental Studies

Teaching Scheme:
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week

Examination Scheme:
In-Semester: **75** Marks
End-Semester: **50** Marks
Credits: 4

Course Objectives:

1. To understand the environment and its effects
2. Apply reasoning skills to environmental problems including basic calculations related to energy.
3. To understand the importance of ecological balance for sustainable development. Understand the relevance and importance of natural resources in the sustenance of life on earth and living standard.

Course Outcomes:

1. Understand that life in a viable ecosystem should be the most desirable goal and not wealth or consumption of resources
2. Enhance and strengthen the natural resources base so that need of all is fulfilled today and in future.
3. Create awareness about sustainable development.
4. Identify different types of environmental pollution and control measures.

Unit – I: Multidisciplinary nature of environmental studies (06)

Definition of Environment, multidisciplinary nature of Environmental Studies, scope, importance of Environment, Public awareness for Environment Concept, Ecosystem characteristics:-Biotic abiotic, functional attributes, Energy flow in ecosystem: - Universal and single channel energy flow model, Nutrient Cycling:- Nitrogen cycle, carbon cycle, phosphorus cycle, Biodiversity and its conservation- Definition- Genetic, Species and ecosystem diversity, Value of biodiversity: - food, drugs, medicine, fuel, social, ethical, aesthetic and ecosystem service value

Unit – II: Natural resources- Utilization and conservation (06)

Renewable and Non-renewable resources, Energy resources: - Growing energy needs, use of alternate energy resources, case studies. Limitations of Renewable and Non-renewable resources, Lack of sustainability of modern society, towards sustainable development

Unit – III: Environmental Pollution (06)

Introduction, Classification of pollution **-** Air, water, soil, marine, noise, thermal and nuclear hazards. – sources , causes, effects & remedial measures ,Solid waste generation, Collection of solid wastes, processing techniques, E- waste generation and methods of disposal ,Role of an individual in prevention of pollution.

Unit – IV: Disaster Management (05)

Types and classification of Disaster – Earthquakes, floods, Tsunami, cyclones, landslides, drought, volcanoes , forest fires, avalanches, soil erosion, Disaster Management- meaning, Concept, approaches, principles, Resettlement and rehabilitation of the victims of the disaster

(06)

Unit – V: Social Issues and Environment

Urban problems related to energy, Climate change, global warming, acid rain, ozone layer depletion ,Water conservation and Rain water harvesting ,Human health and environment, Introduction to Environmental Impact Assessment - Definition, introduction of methods with the help of a case study, Environment Protection Act, Forest Conservation Act, Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act , Wild life protection Act, Public awareness

Unit – VI: Sustainable Development **(05)**

Emergence of Global Concern for Environment and Development, Management strategies of sustainable development, Smart City**,** Concept and features of smart city, challenges of urbanization, selection process, strategy

Reference Books:

1. D.L. Manjunath, '**Environmental Studies'**, *Pearson Education,* 1st edition, (2007).
2. E. Bharucha, '**Text Book of Environmental Studies**', *UGC, Universities Press,* 1st edition*,* (2005)
3. D.K. Asthana ,Meera Asthana, '**A Text Book Of Environmental Studies',** *S.Chand,*3rd edition,(2009)
4. Dr. J.P. Sharma, **'Environmental Studies',** *University Science Press,* 3rd edition, (2013)
5. Dr. S. K. Dhameja, **'Environmental Studies'**, *S.K.Kataria & Sons,* 4th edition, (2012)
6. C.P.Kaushik, **'Perspectives in Environmental Studies',** *New Age International Publisher,* 1st edition, (2014).
7. Shah, Kale, Patki, **'Building planning and Built environment**',*Tata McGraw Hill,* 4th edition, (2002)
8. R. Bukhootsow, '**Energy policy and planning**'**,** *B- Prentice Hall of India New Delhi,* 1st edition, (2003)

HSEL 2101 B) Economics for Engineers

Teaching Scheme:
Lectures: 3 Hrs/Week
Tutorial: 1 Hr/Week

Examination Scheme:
In-Semester: **75** Marks
End-Semester: **50** Marks
Credits: 4

Course Objectives:

1. The objective of this course is to familiarize the prospective engineers with elementary principles of economics.
2. It also deals with acquainting the students with standard concepts and tools that they are likely to find useful in their profession when employed in the firm/industry/corporation in public or private sector.
3. It also seeks to create awareness about the status of the current economic parameters /indicators/ policy debates.
4. All of this is a part of the quest to help the students imbibe soft skills that will enhance their employability.

Course Outcomes:

1. Awareness of the economic side of the state of affairs of a country.
2. Apply economic tools at work place.
3. Know the various sources of Finance.
4. Understand Government policies and their impact on economy, international perspective to business and economy.

(10)

Unit – I: Basic Principles and Methodology of Economics.
Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes

Unit – II: Public Sector Economics **(10)**
Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.

Unit – III: Elements of Business/Managerial Economics **(10)**
Forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money. Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.

Unit – IV: Indian economy **(10)**
Brief overview of post independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and

Policy Debates in Monetary, Fiscal, Social, External sectors. International Economy, WTO.

Reference Books:

1. M. Gregory N, **Principles of Economics**, *Thompson Asia*, 2nd edition, (2002)
2. V. Mote, S. Paul, G. Gupta, **Managerial Economics**, *Tata McGraw Hill,* 1st edition,(2004)
3. S.K Misra, Puri, **Indian Economy**, *Himalaya,* 1st edition, (2009)
4. P. Saroj, **Textbook of Business Economics**, *Sunrise Publishers*, 1st edition, (2003)
5. Krugman, **International Economics**, *Pearson Education*, 2nd edition*,(2009)*
6. Prakash, **The Indian Economy**, *Pearson Education,* 1st edition, (2009)
7. T. Gerald, **Engineering Economics**, *Prentice Hall,* 9th edition, (2008)
8. **"Industrial Organisation and Engineering Economics"**, *Khanna Publishers,* 24th edition, (2009)

HSEL2101 C) Fundamentals of Disaster Management

Teaching Scheme: **Examination Scheme:**
Lectures: 3 Hrs/Week In-Semester: **75**Marks
Tutorial: 1 Hr/Week End-Semester: **50** Marks
Credits: 4

Course Objectives:

1. To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences
2. To increase the knowledge and understanding of the International Strategy for Disaster reduction and to increase skills and abilities for implementing the Disaster Risk Reduction Strategy.
3. To ensure skills and ability to design, implement and evaluate research on disasters.

Course Outcomes:

1. Integrate knowledge and to analyze, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.
2. Describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.
3. Work theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery) and relate their interconnections, particularly in the field of the Public Health aspects of the disasters.
4. Manage the Public Health aspects of the disasters.
5. Obtain, analyze, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios with the ability to clearly present and discuss their conclusions and the knowledge and arguments behind them

Unit – I: Introduction :Concepts and definitions (06)

Disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation).Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility Authority.

Unit-II: Disaster Impacts (06)

Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psychosocial issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Unit-III : Disaster Risk Reduction (DRR) (06)

Disaster management cycle its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction,

DRR programmes in India and the activities of National Disaster Management

Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority).
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. P. Sahni, **"Disaster Risk Reduction in South Asia",** *Prentice Hall.* 1st edition, (2004)
4. K. Singh, **"Handbook of Disaster Management: techniques & Guidelines",** *Rajat Publication,* 1st edition, (2008)
5. G. K. Ghosh**, "Disaster Management"**, *APH Publishing Corporation,* 1st edition, (2006)

OE 2101 A) Clinical Engineering

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:

1. An ability to identify, formulate and solve a problem of Biomedical Instrumentation Engineering.
2. An ability to design different clinical laboratory instruments and ability to analyze and and interpret data.
3. To study Health Informatics
4. To study Ethics and Professionalism

Course Outcomes:

1. To be able to select and use latest hardware and software tools for various biomedical systems design.
2. To be able to apply knowledge of mathematics, Science and Engineering to Biomedical Instrumentation Discipline.
3. Able to implement e-health services, Medical data formats.
4. Able to implement Safety Concepts

Unit – I: Introduction **(06)**

Clinical Engineering evolution, Models of Clinical Engineering Practice; Technology Management, Medical Standards, Hospital design.

Unit – II: Medical Devices **(06)**

Design, Manufacture, and Evaluation and Control of Medical Devices, Utilization and service of medical Devices.

Unit – III: Health Informatics **(06)**

Health-Care Delivery Systems-Organization, Economics, Codes & Standards, Information Flow and Handling-health services, Medical data formats.

Unit – IV: Safety Concepts: **(06)**

Clinical Engineering Program, Safety education and Program, Hospital safety Regulations.

Unit – V: Medical Informatics: **(06)**

Introduction to Medical Informatics, Structure of medical informatics, Functional capabilities of hospital information system, electronic patient records.

Unit – VI: Ethics and Professionalism: **(06)**

Professionalism and Ethics. Guidelines and standards for best practices, hospital management and legal aspects.

Text Books:

1. J. Carr, **"Introduction to Biomedical Equipment Technology",** 1998, *PHI*
2. Yadin David, **"Clinical Engineering – Principles and Applications in engineering",***CRC Press*,
3. J.G. Webster, A.M. Cook - Editor, **"Clinical Engineering: principles and practices",**1979, *Prentice Hall*

4. Joseph F. Dyro, **"Clinical Engineering Handbook"** Academic Press Series in Biomedical Engineering, *Academic Press*
5. R.D.Lele, **"Computers in Medicine Progress in medical informatics",** *Tata McGraw Hill, 2005.*

OE 2101 B) Rehabilitation Engineering

Teaching Scheme:
Lectures:3 Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:

1. To study the concepts of Rehabilitation
2. To study various rehabilitation aids.
3. To study Wheeled Mobility
4. To study Computer Application in Rehabilitation Engineering.

Course Outcomes:

1. Select the appropriate rehabilitation concept for various disabilities.
2. Compare the different methods of orthopedic prosthetics and orthotics for rehabilitation.
3. Repair and maintain power wheel chair.
4. Design and develop orthrotic and prosthetic devices

Unit – I: Introduction to Rehabilitation **(04)**
Definition, Concept of Rehabilitation: Orthrosis & Prosthesis, Types of Physical Impairments, Engineering Concepts in Sensory & Motor rehabilitation.

Unit – II: Orthotics & Prosthetics in Rehabilitation: **(08)**
Material and fabrication for prosthetics and orthotics,
Intelligent prosthetic Knee, Prosthetic Hand, Advance and automated prosthetics and orthotics, 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

Unit – III: Wheeled Mobility **(06)**
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, Manual and powered wheel chair, design of wheel Chair, Tricycle, Walkers, Crutches.

Unit – IV: Sensory Augmentation and Substitutions **(06)**
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

Unit – V: Computer Application in Rehabilitation Engineering **(06)**
Interface in compensation for visual perception, Improvement of orientation and Mobility.

Unit – VI: Rehabilitation Aids for Mentally Impaired **(06)**
Sleeping Aids, Walking Aids, Seating Aids, Postural Aids.
Artificial Organs: kidney, heart, pancreas, liver

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)
5. Webster, John G. et al, **"Electronic Devices for Rehabilitation"** *John Wiley & Sons*
6. Cooper Rory A, **Rehabilitation Engineering Applied to Mobility and Manipulation** (Series in Medical Physics and Biomedical Engineering), *CRC Press*

OE2101 C) Bioinformatics

Teaching Scheme:
Lectures: 3 Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
End-Semester: **50** Marks
Credits: 3

Course Objectives:

1. To develop a**dvanced skills to critically analyze and solve problems in biotechnology.**
2. To be enable to evaluate data using bioinformatics.
3. To be able to identify potential uses and opportunities of this data.
4. To be able to understand the recent developments in a specialized area of biotechnology.

Course Outcomes:

1. Ability to explain the basic principles that underpin Bioinformatics analyses.
2. Ability to apply the Bioinformatics principles in analyzing biological data.
3. Ability to synthesize information and analyze biological data using a variety of Bioinformatics tools.
4. Ability to interpret correctly the outputs from tools used to analyze biological data and Make meaningful predictions from these outputs.

Unit – I: Introduction and Resources **(06)**

Information on various databases and bioinformatics tools available. For eg; nucleic acid sequence database (GenBank, EMBL, DDBJ), protein sequence databases (SWISS-PROT, TrEMBL, PIR, PPB)

Unit – II: Machine learning and bioinformatics **(07)**

Introduction to various machine learning techniques and their applications in bioinformatics. Genetic algorithm, Support Vector Machine, Neural Network and their practical applications towards the development of new models, methods and tools for bioinformatics

Unit – III: Sequence Analysis **(07)**

Various file formats for biomolecular sequences - genbank, fasta, gcg, msf, nbrf-pir, etc
Basic concepts of sequence similarity, identity and homology, paralogues.
Sequence based database searches - BLAST and FASTA algorithms

Unit – IV: Sequence Alignment **(07)**

Pair wise and Multiple Sequence Alignments (MSA). Basic concept of sequence alignment, Pair wise alignment (Needleman and Wunsch, Smith and Waterman algorithms), MSA (Progressive and Hierarchical algorithms). Their use for analysis of Nucleic acid and protein sequences and interpretation of results

Unit – V: Markov Chains and Hidden Markov Models(HMM) **(07)**

Introduction to Markov Chains and HMM using Markov chains for discrimination of biological sequences. Forward and Backward algorithms

Unit – VI: Phylogeny **(06)**

Phylogeny analysis, definition and description of phylogenetic trees and its types. Various computational methods in phylogenetic and molecular evolutionary analysis

Text Books:

1. Hooman Rashidi, Lukas K. Buehler, '**Bioinformatics Basics: Applications in Biological Science and Medicine'** (2nd Edition) (May 2005)
2. Des Higgins (Ed),Willie Taylor (Ed), **'Bioinformatics: Sequence, Structure and Databanks - A practical approach'** (1st Edition) (October 2000)
3. 3. N.J. Chikhale and Virendra Gomase, **'Bioinformatics- Theory and Practice'** (1st Edition)(July 2007)

INBI 2102 Project Phase-I

Teaching Scheme:
Practical: 18 Hrs/Week

Examination Scheme:
In-Semester: **50** Marks
Oral: **50** Marks
Credits: 9

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 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.

INBI 2201 Project Phase-II

Teaching Scheme:
Practical: 28 Hrs/Week

Examination Scheme:
In-Semester: **150** Marks
Oral :**100** Marks
Credits: 14

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.