# SCHEME OF INSTRUCTION & EXAMINATION

**B.E. IV/IV**

*(BIOMEDICAL ENGINEERING)*

## SEMESTER II

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<th>S.No.</th>
<th>Syllabus / Ref. No.</th>
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<td>Biomedical Signal Processing</td>
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## PRACTICAL

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<th></th>
<th>BM 481 UE</th>
<th>Biomedical Signal Processing Lab</th>
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<td>BM 483 UE</td>
<td>Project</td>
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<td>6</td>
<td>Viva Voce</td>
<td>Grade*</td>
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**TOTAL** 12 12 275 175 28

## ELECTIVE III

- BM 452UE  Medical Image Processing
- BM 455UE  Biomems and Nanobiomedicine
- EC 455UE  Embedded System Design
- EE 451UE  Reliability Engineering
- ME 455UE  Composite Materials

## ELECTIVE IV

- BM 453UE  Physiological Systems Modeling
- BM 454UE  Bioelectricity
- CS 463UE  Data Mining
- ME 460UE  Robotics
- LA 454UE  Intellectual Property Rights
BM 451 UE

BIOMEDICAL SIGNAL PROCESSING

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination 75 Marks
Sessional: 25 Marks
Credits 4

OBJECTIVES:

a. Know the Origin of brain waves and their characteristics.
b. Distinguish between normal patterns and transients, typical of epileptic patients.
c. Detect the sleep stages and duration spent has been known.
d. Design Adaptive filters for Cancellation of noise in various applications
e. Determine different morphologies of the waveform and parameters that characterize them.
f. Reduce the redundancies while preserving significant content for reconstruction and interpretation.

UNIT I


UNIT II


UNIT III

Adaptive noise canceling: Principles, LMS adaption algorithm, noise canceling methods to enhance ECG monitoring. Fetal ECG monitoring, Electrosurgical interference cancellation and donor heart interference cancellation.

UNIT IV


UNIT V

VLSI in digital signal processing: High performance VLSI signal processing, VLSI application in medicine, VLSI sensors for Biomedical signals, VLSI tools. Selection of custom, ASIC, or off-the-shelf components.

Suggested Reading:
BM 452 UE

**MEDICAL IMAGE PROCESSING**

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination 75 Marks
Sessional: 25 Marks
Credits 4

**OBJECTIVES:**
a. Various Medical Services in a Hospital.
b. Plan and Design Hospital System.
c. Know the Role Responsibilities of Higher Authorities and Biomedical Engineer.
d. Create Database by having the knowledge of tables, sets, datamodels and Normalisation Techniques
e. Use the computers effectively in every department of the hospital right form Registration to Laboratories.
f. Methods of history taking by computers and Computerised Medical Record Evaluation.

**UNIT I**

**UNIT II**
Image operations: Gray level Transformation – image negatives, image subtraction, contrast enhancement, thresholding, histogram techniques, filtering- low pass and high pass in spatial and frequency domain, derivative filters, homomorphic filters.

**UNIT III**
Radiography and CT: X-rays: interaction of X-ray beam with tissue – ray detection, data acquisition in CT, Images reconstruction, computed axial tomography, generation of CT, spiral CT, mammography, computed radiography (CR).

**UNIT IV**
Magnetic resonance imaging: image acquisition and reconstruction, interaction with tissue, slice selection, basic pulse sequences, fast imaging methods, functional imaging, fMRI, Diffusion tensor imaging.

**UNIT V**
Ultrasonic imaging and nuclear imaging: physics of acoustic waves, Wave propagation in tissues, generation and detection of ultrasound, B-mode, M-mode TM-mode processing – Data acquisition and reconstruction of Doppler image – pulsed wave Doppler, NMI-Radio active decay modes, data acquisition, PET SPECT.

**Suggested Reading :**
**BM 455 UE**

**BIOMEMS AND NANOBIOMEDICINE**

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits: 4

**OBJECTIVES:**

1. Provide general design techniques for miniaturized biomedical sensors, actuators and bioMEMS using simulation, materials science, semiconductor systems, optoelectronics, microelectronics circuits, electrochemical solid state devices, and transducer platforms.
2. Analyze design concepts of interface silicon/cell systems and integrated bioMEMS devices based on lab-on-a-chip concepts for DNA analysis, bacteria detection, cell research, cell statistics, drug delivery, biomedical sensors and actuators.
3. Develop multi-disciplinary research skills on system and fabrication design of innovative lab-on-a-chip integrated biomedical devices involving technical, feasibility, device performance, cost, and market need analysis.

**UNIT I**
Introduction to MEMS: MEMS and Microsystems and microelectronics. Microsystems and miniaturization. Applications of Microsystems. Materials for MEMS and Microsystems, Packaging materials and smart materials

**UNIT II**
Nanoscience and nanotechnology. Nanoscience and nanotechnology in biology and medicine: An Overview, Nanomaterials, quantum well, wire, dot, carbon nanotubes

**UNIT III**
Nanomaterials Fabrication: Bottom-up vs. top-down, Epitaxial growth ,Self-assembly.

**UNIT IV**
Nanomedicine: Drug delivery to cells using nanotubes and nanowires, Quantum Dots for drug discovery and imaging, Quantum Dots and gold nanoparticles for cancer treatment, Nanoparticle mediated gene therapy, Growth of neurons on Nanomaterials, Nanomaterials for brain protection and repair, Nanorobotics for surgery

**UNIT V**
Nanobiosensors: Nanosensor probes for single living cells, Silicon nanowires for monitoring drug interaction, Carbon nanotubes for monitoring Antibody-Antigen Reaction, DNA switch, DNA biochips, Cantilever nanosensors for identifying genetic sequences Nanotoxicology

**Reference Books:**
EC 455 UE

EMBEDDED SYSTEM DESIGN

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination 75 Marks
Sessional: 25 Marks
Credits 4

OBJECTIVES:
a. Aspects of the design and development of an embedded system, including hardware and embedded software development.

UNIT I
Introduction to 8051 and operating modes – addressing modes – instruction set – on chip memories – on chip timers & counters, serial ports – interrupt control.

UNIT II

UNIT III

UNIT IV

UNIT V
Debugging – simulators – emulators – EPROM emulators – software development cycle- programming using assembly language and C.

Suggested Reading:
EE 451 UE

RELIABILITY ENGINEERING

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination 75 Marks
Sessional: 25 Marks
Credits 4

OBJECTIVES:

a. New tools in reliability engineering principles
b. How operations can improve reliability of their processes
c. How someone can calculate the cost of unreliability for making business decisions to attack problems of unreliability.
d. Find out reliability tools helpful for providing supporting evidence during root cause analysis failure investigations
e. Find reliability tools and techniques helpful for understanding failure data

UNIT I

UNIT II
Failure and causes of failure. Failure rate and Failure density. Reliability function MTTF. Bath tub curve for different systems. Parametric methods or above distributions. Nonparametric methods from filed data.

UNIT III
Reliability block diagram. series and parallel system. Net work reduction technique, examples. evaluation of failure rate, MTITE and reliability, active and stand by redundancy, r out of n configuration. Non-series- parallel systems. Path based and cut set methods.

UNIT IV
Availability, MTFR and NTBF Markov models and state transition matrices. Reliability modes for single component, two component. Load sharing and standby systems. Reliability and Availability models of two unit parallel system with repair and standby system with repair.

UNIT V

Suggested Reading:
ME 455 UE

COMPOSITE MATERIALS

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits: 4

OBJECTIVES:

a. Provide training in the analysis, response/behavior, design, selection, repair and recycling of anisotropic and/or composite materials - including societal and fiscal considerations.

UNIT I
Introduction: Fibres, matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon fibre composites.

UNIT II
Micromechanics of composites:
Mechanical properties production of elastic constant, micromechanical approach, Halpin- Tsai equations, transverse stresses.
Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

UNIT III
Micromechanics of composites:
Elastic constants of a lamina, relation between engineering constants and reduced stiffness and compliance, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation.

UNIT IV
Inter- laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams. Tensile and compressive strength of unidirectional fibre composites, fracture mode in composite: single and multiple fracture, de-bonding, fibre pullout and de-lamination failure, fatigue of laminate composite. Effect of variability of fibre strength.

UNIT V
Strength of an orthotropic lamina: maximum stress theory, maximum strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials.
Measurement of constituent material properties: fibre tests, matrix tests.
Measurement of basics composite properties: tensile test, compressive test, a plane shear test, interlaminar shear test, flexure test.

Suggested Reading:
BM 453 UE

PHYSIOLOGICAL SYSTEMS MODELING

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination 75 Marks
Sessional: 25 Marks
Credits 4

OBJECTIVES:

a. To appreciate the value and application of physiological models
b. To understand the process of modeling dynamically varying physiological systems
c. To understand methods and techniques to analyze and synthesize dynamic models
d. To develop differential equations to describe the dynamic behavior of physiological systems
e. To simulate and visualize dynamic responses of physiological models using computers
f. To solve and implement a modeling and design problem from inception to completion

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V
Tracer dynamics: Organ compartment model to relate Organ volume and flow-rate to monitored trace concentration, administration and its time profile. Model for measuring carbohydrate metabolism from monitoring of intravenously injected glucose.

Suggested Reading:
BM 454 UE

BIOELECTRICITY

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits: 4

OBJECTIVES:
a. Electrical properties of the cell membrane
b. Action potentials
c. Extra cellular waveforms
d. Cardiac electrophysiology
e. Function stimulation (FES)

UNIT I

UNIT II

UNIT III

UNIT IV
Electro-physiology of Heart: Properties of Cardiac muscle, Heart vector, electrical activity of the heart. Standard leads, lead vectors. Recording of the ECG from the surface. Dipole theory of the heart. Relationship between the different ECG leads.

UNIT V
Application of Bio-Electric Phenomena:
Functional Neuro-muscular stimulation, impedance plethysmography, measurement of resistance of isotropic & anisotropic tissue and Electro encephalography.

Suggested Reading:
DATA MINING

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination 75 Marks
Sessional: 25 Marks
Credits 4

OBJECTIVES:
a. To introduce students to the basic concepts and techniques of Data Mining.
b. To develop skills of using recent data mining software for solving practical problems.
c. To gain experience of doing independent study and research.

UNIT I
Data Warehousing: Introduction, What is a DWH. Definition, Multidimensional data model, OLAP operations, Warehouse schema, DWH architecture, Warehouse server, Metadata OLAP engine, DWH Backend process.

UNIT II

UNIT III
Clustering Techniques : Introduction , Clustering Paradigms, Partitioning algorithm, K-Medoid algorithm, CLARA, ALARANS, Hierarchical Clustering , DBSCAN ,BIRCH, CURE, Categorical Clustering algorithms, STIRR, ROCK, CACTUS
Other Techniques: Introduction, What is a NN, Learning in NN, unsupervised Learning , data Mining using NN : A case study, genetic algorithm, Rough sets, support vector machines.

UNIT IV

UNIT V

Suggested Reading:
1 Arun K Pujari, Data Mining Technique, University Press, 2001.
2 Jiawei Han , Micheline Kamber, Data Mining: Concepts and Techniques, Morgarn Kaufmann Publishers, 2006.
3 Rajeev Paride, Principles and Implementation of Data Warehousing, Firewall Media , 2006
ME 460 UE

ROBOTICS

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination 75 Marks
Sessional: 25 Marks
Credits 4

OBJECTIVES:

a. The goal of the course is to familiarize the students with the concepts and techniques in robot manipulator control, enough to evaluate, chose, and incorporate robots in engineering systems.

UNIT I

UNIT II

UNIT III
Jacobian for direct and inverse kinematics. Trajectory planning for robots. Trajectory control based on incremental inverse kinematics of kinematics of equations, Static force analysis, stiffness.

UNIT IV
Newton – Euler formulation of dynamic equation. Lagrange formulation. Inertia tenser. Control schemes, individual joint control and disadvantages. Control through computed torques.

UNIT V

Suggested Reading:
INTELLECTUAL PROPERTY RIGHTS

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination 75 Marks
Sessional: 25 Marks
Credits 4

OBJECTIVES:
a. To provide an understanding of basic concepts of IP relating to technology
b. To give an insight into IP Management, Licensing, Valuation, Audit and other aspects of IP.
c. To teach basic skills necessary for a good IP hygiene within the company.

UNIT I
Meaning of intellectual property Rights. Justification of intellectual property Rights. Classification of thee rights. Classification of Treaties relating to intellectual property Rights- (i) Stranded setting treaties (ii) Global protection system treaties. (iii) Classification treaties. The salient features of the TRIPS Agreement. The two international institutions – (i) The world intellectual property organization (ii) the world trade organization.

UNIT II
History of the patent system. Patents in all fields of technology.

i. Patent on genetic resources patents on chemicals, designs, patent based on software, business methods, internet patent, etc.
ii. Exception to exclusive rights conferred to a patent holder.
iii. Ground for revocation f patent.
iv. Remember for infringement of a patent.

UNIT III

UNIT IV
Nature and scope of protection of design rights, protection of layout designs (topographies) of integrated circuits, protection of undisclosed information, protection of trade marks, domain names and geographical indications.

UNIT V
Practical aspects – drafting of a patent. Some exercises on the preliminary rules on preparing an application seeking a patent.

Suggested Reading:
Enrollment studies

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits: 4

Objectives:

a. Describe the regions of the biosphere and explain how organisms interact within the biosphere.
b. Define and describe the various biomes of the world.
c. Describe an invasive species and discuss its impact on the environment.
d. Identify biotic and abiotic factors of an ecosystem and be able to describe their interaction.
e. Describe the main materials cycles of nitrogen, carbon, oxygen and phosphorous.
f. Identify and understand humankind's impact on atmosphere, soils and hydrologic cycles.

Unit I
Environmental studies: definition, scope and importance, need for public awareness. Natural resources: water resources; use and over utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. Effects of modern agriculture, fertilizer-pesticide problems, water logging salinity. Energy resources; growing energy needs, renewable and non-renewable energy sources. Land resources; land as a resource, land degradation soil erosion and desertification.

Unit II
Ecosystems: concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in ecosystem, food chains, ecological pyramids, aquatic ecosystem(ponds, streams, lakes, rivers, oceans, estuaries).

Unit III

Unit IV
Environmental Pollution: causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid waste management. Environment protection act: Air, water, forest & wild life acts, issues involved in enforcement of Environmental legislation.

Unit V
Social issues and the Environmental: water conservation, watershed management, and Environmental ethics. Climate change global warming acid, rain, ozone layer depletion. Environmental protection act, population explosion.

Suggested Reading:
1. K. De, Environmental chemistry, Wiley astern Ltd
BM 481 UE

BIOMEDICAL SIGNAL PROCESSING LAB

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 75 Marks
Sessional: 25 Marks
Credits: 4

1. Use of DSP processors-6X and 2X series for
   (i) Generation of basic signals.
   (ii) Linear and circular convolution
   (iii) Realization of FIR and IIR filters
   (iv) Finding DFT and IDFT of given sequence
   (v) Plotting the power spectral density.

2. Computation of convolution and correlation sequences.
3. Signal averaging improvement in the SNR Using coherent and incoherent averaging.
4. Exponential averaging.
5. Data polishing: mean and 0trend removal
6. Design of IIR and FIR Filter
7. PSD Estimation
8. AR Modeling for Predictive Filters
9. LMS Based Algorithm for Adaptive Noise Canceling
10. Data Compression Techniques: AZTEC, TP, CORTES, KL Transform
11. Template matching algorithm for QRS detection
12. Classification of EEG waves.
Oral presentation is an important aspect of engineering education. The objective of the seminar course is to motivate a student to do a systematic and independent study of state-of-art topics in a broad area of his/her interest.

Seminar topics may be chosen by the student with the suggestions from the faculty members. Students are to be exposed to following aspects of seminar presentation.

Students are to be exposed to following aspects of seminar presentations.

- Literature survey
- Organization of material to be presented
- Preparation of OHP/Slides/PC Presentation
- Technical writing.

Each student is required to

1. Submit one page synopsis of the seminar talk for display on notice board of the department.
2. Give a 20 minutes presentation with the aids of an OHP/PC/Slide projector, followed by a 10 minutes discussion.
3. Submit the report is on the seminar topic presented along with list of reference and slides/ transparencies used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule should be discouraged.

Sessional marks will be awarded jointly or independently by at least two faculty members. The awards e on the basis if the oral presentation made, written materials submitted, active participation of the student in the proceeding as well as involvements in the discussions.
With effect from the academic year 2010-2011

BM 483 UE

PROJECT

Instruction: 6 Periods per week
Duration of University Examination: Viva voce
University Examination Grade
Sessional: 50 Marks
Credits 12

‘Solving a real life problem’ should be the focus of U.G. project. Faculty members should propose the project briefs (scope and references) well in advance, which should be made available to the students at the department library. The project could be classified as hardware, software, modeling, and stimulation. It should involve one or many elements of techniques such as analysis, design and synthesis.

The department will appoint a project coordinator who will coordinate the following:

- Grouping of students (max. 3 in a group)
- Allotment of projects and projects guides
- Project monitoring at regular intervals

All projects allotment is to be completed by the 2nd week of 4th year 1st semester, so that students get sufficient time for completion of the project.

All projects will be monitored at least twice in a semester through students’ presentation. Sessional marks are to be based on the Grades/Marks, awarded by a monitoring committee comprising of faculty members as well as by the supervisor.

Efforts should be made that some of the projects are carried out in industries with the help of industry coordinators. Problems can also be invited from the industries to be worked out through U.G. projects. Common norms will be established for final documentation of the project report by the respective departments.

* Excellent /Very Good / Good / Satisfactory / Unsatisfactory

Note: Three periods will be assigned to each project guide irrespective of the number of projects guided.