With effect from the academic year 2016-2017

SCHEME OF INSTRUCTION & EXAMINATION
(BIO-MEDICAL ENGINEERING)

B.E. SEMESTER-IV

<table>
<thead>
<tr>
<th>S. No</th>
<th>Course Code</th>
<th>Course Title</th>
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<th>P</th>
<th>Hrs/Wk</th>
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<td>Transducer &amp; Biosensors Engineering</td>
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With effect from the academic year 2016-2017

PC401BM

BIOMEDICAL INSTRUMENTATION

<table>
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<th>3 Periods per week</th>
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<td>Duration of University Examination</td>
<td>3 Hours</td>
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<tr>
<td>University Examination</td>
<td>70 Marks</td>
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<td>Sessionals</td>
<td>30 Marks</td>
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<td>Credits</td>
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Objectives:
- The study of Biopotentials and electrodes are used to construct instrumentation systems to acquire and process different physiological signals.
- The use of display devices and recorders are also considered, and can be used to display or record type acquired signals.
- The students learn about analytical instruments and their working features along with their medical applications.

Outcomes:
- Students can acquire and process different physiological signals
- Students will learn about analytical instruments and their working features
- They understand the usage of various display devices and recorders.

UNIT-I

UNIT-II

UNIT-III

UNIT-IV
UNIT-V

**Medical Analytical Instrumentation:** Methods of chemical analysis. Absorption Photometry, emission photometry, Flurometry, Colorimeter, spectrophotometer, Flame photometer, Mass spectrophotometer, Electrophoresis, chromatography, blood gas analyzer, Semi and fully automated analyzers.

**Suggested Readings:**
With effect from the academic year 2016-2017

PC402BM

TRANSDUCER AND BIOSENSORS ENGINEERING

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Objectives:
- This course facilitates the students to understand the basic characteristics of transducer.
- They learn the classification of transducers such as temperature, pressure, displacement and piezoelectric transducers.
- Signal conditioning and processing, controllers, display, recording; direct digital control, programmable logic controllers, and PC based instrumentation.

Outcomes:
- Able to understand the characteristics of various transducers and classify transducers
- Students will learn the signal conditioning and processing of Electrochemical transducers
- Fabrication techniques of MEMS and their characteristics are learnt.

UNIT I
Transducers and their classification: Principles of transduction and measurement, Sensor, Transducer, Basic requirements of transducers. Passive and Active transducers. Classification based on application and operating principle medically significant measurands- strain, force, pressure, acceleration, flow, volume, temperature and Biopotentials, Functional specifications of medical sensors; static and dynamic characteristics of first and second order transducers, Primary sensors.

UNIT II
Resistive and self generating Transducers: Principle of operation, associated circuits and applications of Resistive sensors: Potentiometers, Strain gages, RTDs, Thermistors, LDR, governing equations, materials and constructional details of various resistive transducers. Principle of operation, associated circuits and applications of Self-generating sensors. Thermoelectric sensors, thermocouples, piezoelectric sensors, photovoltaic sensors, governing equations, materials and constructional details of various self generating sensors.

UNIT III
Capacitive and inductive transducers: Principle of operation, associated circuits and applications of Capacitive sensors, governing equations, materials and constructional details of capacitive transducers, Principle of operation, associated circuits and applications of Inductive transducers, governing equations, materials and constructional details of Inductive transducers, LVDT and Hall effect transducers.

UNIT IV

UNIT V
Bio-MEMS: Introduction to MEMS, Micro and nano scale devices, Fabrication techniques of MEMS and their characteristics, Solid state transducers, optical transducers, electrochemical transducers, biomedical microelectronics. Clinical applications.

Suggested Reading:
With effect from the academic year 2016-2017

ES403BM

SIGNALS AND SYSTEMS FOR BIOMEDICAL ENGINEERS

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Objectives:
- To Identify and use the following elementary signals: exponentials, sinusoids, complex exponentials, exponentially damped sinusoids step functions, impulses, sifting and time scaling properties of impulses.
- To evaluate the time domain signal corresponding to DTFS, FS, DTFT, and FT representations using the defining equations.
- To determine whether an input/output description for a system has the following properties: stability, memory, memory less, causality, invertibility (simple cases), time invariance, and linearity.
- To evaluate the convolution sum and integral given an input and the impulse response.

Outcomes:
- Students can identify and use the following elementary signals: exponentials, sinusoids, complex exponentials, exponentially damped sinusoids step functions, impulses, sifting and time scaling properties of impulses.
- Students can analyze time domain signal corresponding to DTFS, FS, DTFT, and FT representations using the defining equations.

UNIT I: Introduction
signal and system, classification of signals, Energy and power signals, Periodic and Aperiodic signals, Even and odd signals, Impulse function, Unit step function, Ramp function, Rectangular function, constant function, Signum function, Right hand sided exponential function, and left hand sided exponential function, operations on signals, Types of systems, linear and Non-linear systems, Time variant and time invariant systems, Causal and non-causal systems, Invertible and non-invertible systems, stable and unstable systems.

UNIT II: Fourier Series and Fourier transform
Analogy between vector and signal, Signal representation by discrete set of orthogonal; functions, Exponential and trigonometric Fourier series, convergence, Dirichelet’s conditions, the discrete Spectrum, limitations of Fourier series. The direct and inverse Fourier transform, continuous spectrum, Existence and properties of Fourier transform, Parseval’s theorem, Fourier transform of periodic functions, Limitations of Fourier transform.

UNIT III: LTI systems
Convolution integral, Properties of convolution, convolution as summation, graphical method of convolution, Applications of convolution, Correlation, Auto correlation, Cross correlation, applications of correlation, Sampling of continuous time sampling, sampling theorem and problems, Nyquist rate, Aliasing effect, Reconstruction methods of signals.

UNIT IV: DFT & DTFT
UNIT V: FFT

Suggested Reading:
With effect from the academic year 2016-2017

**HS901BT**

**ENVIRONMENTAL SCIENCES**

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**Objectives:**
- This course facilitates the students to understand the basic concepts of environmental studies. The study of eco systems, environmental pollution and the social issues are discussed. The students in future take a keen look on the environment, when new things are implemented.

**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 and salinity.

**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).
*Energy resources:* Growing energy needs renewable and non-renewable energy sources. Land Resources, land as a resource, land degradation, soil erosion and desertification.

**UNIT III**
*Biodiversity:* Genetic species and ecosystem diversity, bio-geographical classification of India. Value of biodiversity, threats to biodiversity, endangered and endemic species of India, conservation of biodiversity.

**UNIT IV**
*Environmental Pollution:* Causes, effects and control measures of air pollution, water Pollution, soil pollution, noise pollution, noise pollution, thermal pollution and solid waste management.
*Environment protection act:* Air, water, forest and wild life Acts, enforcement of Environmental legislation.

**UNIT V**
*Disaster management:* Types of disasters, impact of disasters on environment, infrastructure and development. Basic principles of disaster mitigation, disaster management, and methodology, disaster management cycle, and disaster management in India.

**Suggested readings:**
BS406MT

MATHEMATICS-III

Instruction 4 Periods per week
Duration of University Examination 3 Hours
University Examination 70 Marks
Sessionals 30 Marks
Credits 3

Objectives:
- To introduce the concept of functions of complex variables and their properties
- To formulate partial differential equations and to introduce a few methods to solve first order linear and non-linear partial differential equations
- To study Fourier series and its applications to partial differential equations

Outcomes: At the end of the course students will be able to
- Determine the analyticity of a complex functions and expand functions as Taylor and Laurent series
- Evaluate complex and real integrals using residue theorem
- Expand function as a Fourier series
- Find solutions of first order and second order partial differential equations

UNIT-I
Functions of Complex Variables: Limits and continuity of function, differentiability and analyticity, necessary & sufficient conditions for a function to be analytic, Cauchy- Riemann equations in polar form, harmonic functions, complex integration, Cauchy’s integral theorem, extension of Cauchy’s integral theorem for multiply connected regions, Cauchy’s integral formula, Cauchy’s formula for derivatives and their applications.

UNIT-II
Residue Calculus: Power series, Taylor’s series, Laurent’s series, zeros and singularities, residues, residue theorem, evaluation of real integrals using residue theorem, bilinear transformation, conformal mapping.

UNIT-III
Fourier series: Fourier series, Fourier series expansions of even and odd functions, convergence of Fourier series, Fourier half range series.

UNIT-IV
Partial differential equations: Formation of first and second order partial differential equations, solution of first order equations, Lagrange’s equation, Nonlinear first order equations, Charpit’s method, higher order linear equations with constant coefficients.

UNIT-V
Fourier series applications to partial differential equations: Classification of linear second order partial differential equations, separation of variables method (Fourier method), Fourier series solution of one dimensional heat and wave equations, Laplace’s equation.

Suggested Reading:
ES422EC

DIGITAL ELECTRONICS

Instruction: 4 Periods per week
Duration of University Examination: 3 Hours
University Examination: 70 Marks
Sessional: 30 Marks
Credits: 3

Objectives:
- This course facilitates the students to study the properties for Boolean algebra and simplification of Boolean equations using K-maps.
- The digital circuits’ classification is studied and the main elements of this classification are studied. Application of these circuits to build a basic computer is discussed.
- The students also learn about different types of memories and how they are programmed.
- The course also discuss about the basic applications of digital electronics like digital clock, frequency counter.

Outcomes:
- Students understand the properties for Boolean algebra and simplification of Boolean equations using K-maps
- Students understand about different types of memories and how they are programmed
- Students understand the conversion process in ADC and DAC

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
Introduction to DAC, ADC: Sampling, Quantization, quantization noise, aliasing and reconstruction filtering, Specifications, DAC Conversion, Binary weighted Resistor DAC, R-2R Ladder DAC, Inverted (or) Current mode DAC, Sample and hold circuits, ADC conversion, Types of ADCs: Direct Conversion ADC/Flash type ADC, Successive approximation ADC, Integrating ADCs, Sigma-Delta ADCs, Analog Multiplexers.

Suggested Reading:
With effect from the academic year 2016-2017

PC451BM

BIO-MEDICAL INSTRUMENTATION LAB

Instruction 2 Periods per week
Duration of University Examination 2 Hours
University Examination 50 Marks
Sessionals 25 Marks
Credits 1

1. Operation of Various transducers
   A. Linear Variable Differential Transformer (LVDT)
   B. Strain Gauge Experiment
   C. Potentiometric Transducer as a displacement Transducer
   D. Light Dependent Resistor (LDR) as a displacement Transducer
   E. Peizo electric Transducer as a pressure transducer
   F. Temperature Transducers
      a) Resistive temperature detector (RTD)
      b) Thermister
      c) Thermocouple
   G. Capacitive Transducer
      a) Linear Displacement Transducer
      b) Angular Displacement Transducer
   H. Indirect Measurement of Blood Pressure
      a) Oscillometry method
      b) Auscultatory method
      c) Palpatory method
   I. Tuning Fork experiment to test the Hearing ability
   J. Body mass Index Experiment

2. Operation of various medical Instruments
   a) ECG Recorder
   b) Multi-channel Data acquisition system(Polygraph)
   c) EEG monitoring system
   d) Bedside monitor
   e) Treadmill Test
   f) Pulse Oximeter
   g) pH Meter
   h) Conductivity meter
   i) Colorimeter
With effect from the academic year 2016-2017

PC452BM

VIRTUAL INSTRUMENTATION & SIMULATION LAB

Instruction
Duration of University Examination
University Examination
Sessionals
Credits

3 Periods per week
3 Hours
50 Marks
25 Marks
2

Virtual Instrumentation Lab using MatLab

1. Implementation in Mat Lab
   (i) Generation of basic signals.
   (ii) Linear and circular convolution
   (iii) Realization of FIR and IIR filters
   (iv) Finding DFT, IDFT, STFT, WT of given sequence
   (v) Plotting the power spectral density.
2. Computation of convolution and correlation sequences.
3. Noise reduction techniques.
4. Design of IIR and FIR Filter
5. PSD Estimation

Labview based Instrumentation Lab

1. Introduction to LabVIEW and Data Acquisition
2. Simulation of Biosignals Using Labview
4. Design of an Analog ECG Signal Generator
5. Acquisition of Bio potentials using Biosignals
7. Spectrum analysis of ECG and PCG signal
8. Design of Heart Rate Analyzer
9. Extraction of Brain Waves from EEG
10. Design of a Demand Pacemaker using LabVIEW
11. GPIB Communication using LabVIEW
12. Instrumentation of an amplifier to acquire an ECG Signal
13. Signal Processing of an ECG signal and measuring the Heart Rate
14. Implementation of Digital Filter to remove noise in biosignals
15. Spectrum analysis of Noisy and pure Biosignal
16. Acquire, Analysis and Present an EEG using Virtual Instrumentation
17. Extraction and Analysis of Brainwaves from an EEG Signal
18. Biofeedback system on EMG
19. Acquisition of PCG signal
With effect from the academic year 2016-2017

ES441EC

DIGITAL ELECTRONICS LAB

Instruction
Duration of University Examination
University Examination
Sessionals
Credits

3 Periods per week
3 Hours
50 Marks
25 Marks
2

I. List of Experiments:

1. Clippers and Clampers-Series and Parallel
2. Astable, Monostable and Bistable Multivibrators
3. Logic Gates-AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR
4. Half Adder, Full Adder, Half Subtractor, Full Subtractor
5. Flip Flops-SR, JK, D, T, JK-Master Slave
6. A/D and D/A converters
7. Multiplexers and Demultiplexers
8. Shift register-Series/Parallel-in to Series/Parallel-out
9. CMOS-TTL and TTL-CMOS interfacing
10. BCD-7 segment Display, DPM
11. PLL and Voltage Controlled Oscillator
12. Counters-Decade, Binary, Divide-by-N

II. Mini Project and Design exercises:

Mini project is to be executed batch-wise. Design exercises are to be carried out individually.