Solapur University, Solapur
Syllabus of T.E.(Bio-medical Engineering) Part I & II
w.e.f. Academic Year 2010-11

T.E. (Bio – Medical Engineering) Part I

Sr. No.	Subject	Teaching Scheme				Examination Scheme				
		L	T	P	Total	Th.	TW	POE	OE	Total
1	Bio Medical Instrumentation - I	4	-	2	6	100	25	50		175
2	Biological Modeling & Simulation	4	-	2	6	100	25	---	25	150
3	Microprocessors & Peripherals	4	-	2	6	100	25	50	---	175
4	Principles of Communication	4	-	2	6	100	25	---	--	125
5	Signals & Systems	3	1	2	6	100	25		---	125
	Total	**19**	**1**	**10**	**30**	**500**	**125**	**100**	**25**	**750**

T.E. (Bio-Medical Engineering) – II

Sr. No.	Subject	Teaching Scheme				Examination Scheme				
		L	T	P	Total	Th.	TW	POE	OE	Total
1	Bio Medical Instrumentation -II	4	-	2	6	100	25	50	---	175
2	Medical Imaging-I	3	1	--	4	100	--	--	25	125
3	Bio Statistics	3	-	2	5	100	25	--	--	125
4	Digital Signal Processing	4	-	2	6	100	25	--	--	125
5	Embedded Systems	4	-	2	6	100	25	50		175
6	Mini Project	-	1	2	3	--	25	--	--	25
	Total	**18**	**2**	**10**	**30**	**500**	**125**	**100**	**25**	**750**

T.E. (Bio – Medical Engineering) Part I

Biomedical Instrumentation - I

Teaching Scheme:	**Examination Scheme:**
Lectures: 4 hr/week	Theory: 100 Marks
Practical: 2 hr/week	Term Work: 25 Marks
	POE: 50 Marks

Section I

1**. Laboratory Instruments**

Basic principle, technical specification, working and applications of Analytical and Laboratory Instruments **(14 Hrs)**

1. Spectrophotometer
2. Colorimeter
3. pH meter.
4. Centrifuge
5. Electrolyte Analyzer
6. Blood cell counter
7. Electrophoresis
8. Chromatography and mass spectroscopy
9 Microscopes
10. ELISA reader & WASH

2. Blood Gas Analyzer **(05 Hrs)**

Measurements of Blood pH, pCo2 pO2 and complete Blood Gas analyzer.

3. Blood Flow Measurement **(08 Hrs)**

Electromagnetic, Ultrasonic, NMR and Laser Doppler flow metry, cardiac output measurement, impedance plethysmography

Section II

4. **Pulmonary Function Analyser and Ventilator** **(12 Hrs)**

Respiration measurement technique: Lung volume and capacities. Spirometry, Pulmonary function measurement and analyzer, spirometer and respiratory function analyzer. Oximetry, Ventilators Respiratory Therapy Equipment and Anesthesia Equipment

5. **Heart Lung machine:** **(04 Hrs)**

Working Principle, block diagram, functions, specifications, different parts

6. Audiometers **(05 Hrs)**

Basic audiometer, Pure tone and Speech audiometer, evoked response Audiometry

Term work:

Term work will consist of at least Eight Laboratory Experiments/Demonstrations based on the above syllabus. Test and Assignments/Seminars be suitably graded by teachers and attached in the journal.

Text Books:

1. Handbook of Biomedical Engineering By R.S. Khandpur (TMH Pub).
2. Handbook of Analytical Instruments By R.S. Khandpur (TMH Pub).
3. Medical Instrumentation, Application and Design By J.G. Webster.
4. Medical Electronics – A.G. Patil ,R K Jha, R Hariharan(Excel Books, New Delhi)

References:

1. Encyclopedia of medical devices and instrumentation - J.G. Webster Vol I, II, III, IV (John Willey).
2. Introduction to Biomedical Equipment Technology By Carr.-Brown (Pearson Education Pub)
3. Introduction to Biomedical Engineering – Joseph Bronzino (CRC Press)
4. Various Instruments Manuals.

T.E. (Bio-Medical Engineering) Part-I

Biological Modeling and Simulation

Teaching Scheme:
Lectures: 4 hr/week
Practical: 2 hr/week

Examination Scheme:
Theory: 100 Marks
Term Work: 25 Marks
OE: 25 Marks

Section I

1. Physiological Modeling: **(9 Hrs)**
Steps in Modeling, Purpose of Modeling, lumped parameter models, distributed parameter models, compartmental modeling, modeling of circulatory system, regulation of cardiac output and respiratory system.

2. Model of Neurons: **(13 Hrs)**
Biophysics tools, Nernst Equation, Donnan Equilibrium, Active Transport (Pump) GHK equation, Action Potential, Voltage Clamp, Channel Characteristics, Hodgkin- Huxley Conductance Equations, Simulation of action potential, Electrical Equivalent model of a biological membrane, impulse propagation- core conductor model , cable equations.

Section II

3. Neuromuscular System: **(06 Hrs)**
Modeling of skeletal muscle, mono and polysynaptic reflexes, stretch reflex, reciprocal innervations, two control mechanism, Golgi tendon, experimental validation, Parkinson's syndrome.

4. Eye Movement Model: **(06 Hrs)**
Four eye movements, quantitative eye movement models, validity criteria.

5. Thermo regulatory systems: **(04 Hrs)**
Thermoregulatory mechanisms, model of thermoregulatory system, controller model, validation and application.

6. Modeling the immune response: **(06 Hrs)**
Behavior of the immune system, linearized model of the immune response., Pharmacokinetics Drug delivery

Term Work –

List of Experiments/Assignments:

1. Simulations using MATLAB
2. Simulations using HHSim
3. Simulations using Neurons in Action
4. Developing a model of neuron using NEURON

Text Books:

1. Bioengineering, Biomedical, Medical and Clinical Engg.: A.Teri Bahil.
2. Signals and systems in Biomedical Engg.: Suresh R Devasahayam.
3. Bio-Electricity A quantitative approach by Barr and Ploncey

Reference Books:

1. Biomedical Engineering Handbook by Bronzino (CRC Press)

T.E. (Bio – Medical Engineering) Part I

Microprocessors and Peripherals

Teaching Scheme:
Lectures: 4hr/week
Practical: 2 hr/week

Examination Scheme:
Theory: 100 Marks
Term Work: 25 Marks
POE: 50 marks

Section I

1. Semiconductor Memories **(5 Hrs)**

Memory Classification- RAM, ROM, PROM, EPROM, EEPROM, memory organization, memory expansion, EPROM Programming Methods.

2. Fundamentals of Microprocessor 8085A **(14 Hrs)**

Simple model of Microprocessor, Terminologies used in Microprocessor, Different Phases in Execution Process, Microprocessor and Programmer's model, Languages used for Programming.

INTEL 8085A- Features, Functional Pin Configuration, Architecture, Demultiplexing of address and data bus, Generating different Control Signals ,Study of buffers and decoders, Instruction set- addressing modes, Classification, timing diagrams, programming with assembly language, Single Stepping, single cycle execution, transition state diagram- HOLD,WAIT,RESET & HALT, Stack and Subroutines-Passing parameter techniques, re-entrant and recursive subroutines

3. Memory Interfacing **(3 Hrs)**

Interfacing Different Memory chips (RAM/ROM) with 8085

4. Interrupts **(4 Hrs)**

Basic Concepts, Classification-Hardware & software interrupts, Interrupt structure of 8085, Instruction related to interrupts, Programming using interrupts

Section II

5. Basics of I/O Interfacing **(4 Hrs)**

Concepts of I/O ports, Data transfer techniques, Memory mapped I/O, I/O mapped I/O schemes.

6. Interfacing Chips and applications **(15 Hrs)**

PPI 8255- Features, pin configuration, block diagram, control word format, different operating modes and programming, Interfacing of 8255 in memory mapped I/O and I/O mapped I/O

Applications of 8255: Interfacing of keyboard,7 segment display, stepper motor, relay and thumbwheel switch using 8255,interfacing of ADC(0808/0809),DAC(0808)using 8255.
Timer/Counter -8253/54- Features, pin configuration, block diagram, control word format, different operating modes and programming, Interfacing of 8253 in memory mapped I/O and I/O mapped I/O
Application-Frequency measurement using 8253/54
USART 8251- Features, pin configuration, block diagram, control word format, different operating modes and programming, Interfacing of 8251in memory mapped I/O and I/O mapped I/O

7. Software and Hardware debugging Tools (3 Hrs)
Logic Analyzer, In-Circuit Emulator, Simulator

Term Work:

List of Experiments:

A) Software/simulator based (minimum 10 experiments)
1. Programs based on different addressing modes, arithmetic and logical instructions.
2. Multiplication of two 8-bit numbers using the method of successive addition and shift and add.
3. Division of two 8-bit numbers using the method of successive subtraction and shift and subtract.
4. Block transfer and block exchange of data bytes.
5. Finding the smallest and the largest element in a block of data.
6. Arranging the elements of a block of data in ascending and descending order.
7. Converting two digit numbers to their equivalents
   a) BCD to HEX
   b) HEX to BCD
8. Generating delays of different time intervals using delay subroutines and measurement of delay period on CRO using SOD pin of 8085A.
9. Generation of Fibonacci series
10. A) Separation of single byte from a word.
    B) Addition of these separated bytes and storing the sum at next consecutive ML.
    C) Reversing the upper byte and lower byte of given number.
11. A) 16 bit sum of string of data.
    B) Reversing a string of data.

B) Hardware based (Minimum 6 experiments)
1. Program control data transfer using 8255 PPI
   A) To INPUT data bytes from peripheral port and to store them in memory
   B) To OUTPUT data bytes from memory to peripheral port
2. Study of interrupts by enabling them in main line program and then executing different subroutines when TRAP, RST7.5, RST 6.5 & RST 5.5 are activated
3. Interfacing 7 segment LED display using 8255A- in static & dynamic mode
4. Interfacing ADC0809
5. Interfacing DAC0808

6. Interfacing Stepper motor with MPU using 8255A- in half and full excitation
7. Interfacing of 8253/8254
8. Interfacing of 8251

Text Books:

1. Microprocessor Architecture, Programming and Applications with 8085A-Ramesh Gaonkar-Wiley Eastern Ltd.New Delhi.
2. Microprocessors and Programmmed Logic-Kenneth L.Short-2nd Edition,Pearson Education
3. INTEL- Microprocessor Peripheral hand book, application notes, Manual
4. Fundamentals of Microprocessor and Microcomputer –B Ram-Dhanpat Rai Publication
5. Microprocessor and Peripherals-S.P.Choudhary,Sunita Choudhary-Scitech Publication
6. Microprocessor Architecture, Programming and System featuring 8085-William A.Raut-Cengage Learning Publication

T.E. (Bio – Medical Engineering) Part I

Principles of Communication

Teaching Scheme:
Lectures: 4 hr/week
Practical: 2 hr/week

Examination Scheme:
Theory: 100 Marks
Term Work: 25 Marks

Section I

1. Introduction **(6 Hrs)**

Block schematic of communication system, base band signals, RF bands, Necessity of modulation, types of modulation – AM, FM, PM and Pulse Modulation. Noise types, Noise figure. Introduction to radio wave propagation, ground wave, space wave and sky wave.

2. Amplitude Modulation **(8 Hrs)**

Amplitude Modulation principles, AM envelope, frequency spectrum & BW, phase representation of AM wave, Modulation index, % modulation (Numerical expected)AM transmitters: Block of low level DSBFC, High level DSBFC, Trapezoidal patterns Evolution and descriptions of SSB, Suppression of carrier using balanced modulator, Suppression of unwanted sideband, Methods: Filter system, phase shift & third method vestigial sideband (VSB)

3. Angle Modulation **(8 Hrs)**

Theory of frequency and phase modulation, mathematical analysis, deviation sensitivity, FM and PM waveforms, phase deviation and modulation index, frequency deviation and percentage modulation, angle modulation circuits using varactor diode ,using frequency analysis of angle modulated wave-Bessel function, BW requirements, deviation ratio, Noise and angle modulation, pre-emphasis and de-emphasis.

Section II

4. Pulse Modulation **(08 Hrs)**

Pulse amplitude modulation, Sampling theorem & type: Natural & flat top, PAM modulation circuit, PAM demodulation circuit, TDM and FDM, Crosstalk in TDM, pulse time modulation, generation of PTM signals (direct-indirect method), PWM modulator, PPM modulators, demodulation of PTM.

5. Digital Modulation Techniques and data formats **(08 Hrs)**

Unipolar, Bipolar, RZ, NRZ, Transmission modes ASK, FSK, PSK - coherent, Non- coherent, BPSK, DPSK, QAM. Comparison

6. Coding **(08 Hrs)**

1. Source coding- Quantization types -Uniform, Non- Uniform, PCM, DPCM, ADPCM, DM, ADM.
2. Channel Coding -Types of Errors & codes, linear block codes, error detection & correction, Hamming codes, Look-up table decoding, Binary Cyclic codes, Convolution codes, Encoders, Decoders, Code tree.

Experiment List : (Minimum 10 Experiments)

1) Amplitude Modulation
2) Frequency Modulation
3) Pulse Amplitude Modulation
4) Pulse width Modulation
5) Pulse position Modulation
6) Pulse Amplitude Modulation - TDM
7) PCM-TDM
8) Study of Compander
9) Study of DPCM.
10) Study of ADPCM.
11) Study of DM.
12) Study of CVSD.
13) FSK (freq. Shift keying)
14) PSK (Phase Shift keying)
15) Study of data format

Text Books:

1) Communication System, Analog and Digital
R.P. Singh and S.D. Sapre (THM)
2) Electronic Telecommunication System (4th Edition)
George Kennedy and Bernard Devise (MGH)
3) Louis E. Frenzel 'Principles of Electronic Communication System'-
IIIrd edition - Tata McGraw Hill Publication
4) K. Sam Shanmugam – Digital & Analog Communication (John Wiley)

Reference Books:

1. Introduction to Analog and Digital Communication
Simon Haykin
2. Principle of Digital Communication
Das, Mullik, Chattergy
3. Digital Communication
Sirnon Haykin
4. Principles of communication
Taub & Schilling (MGH)
5. Digital Communication
Ch.kranthi Rekha (Scitech)

T.E. (Bio-Medical Engineering) Part-I

Signals and Systems

Teaching Scheme:
Lectures: 3 hr/week
Tutorial :1 hrs/week
Practical: 2 hsr/week

Examination Scheme:
Theory: 100 Marks
Term Work : 25 Marks

Section I

1. Introduction to signals: **(06)**

Definition of signals, classification of signals: continuous time signals & discrete time signals, operation on signals, properties of signals -even & odd signals, periodic & aperiodic, deterministic & non-deterministic, energy and power, deterministic signals: unit impulse, unit step, unit ramp, exponential & sinusoidal, Singularity function.

2. Linear time- invariant systems: **(08)**

Representation of signals in term of impulses, classifications of systems-linear and nonlinear systems, time variant and time invariant systems, stable and unstable systems, Static and Dynamic systems, Causality, continuous time-LTI systems, The convolution integral, discrete time LTI systems, the convolution sum, Systems described by differential, difference equations, block diagram representation of LTI systems.

3. Sampling: **(04)**

Representation of continuous time signals by its samples, the sampling theorem in time and frequency domain, Reconstruction of signals from its samples using interpolation, The effect of under sampling, aliasing, Discrete time processing of continuous time signals.

Section II

4. Fourier analysis for Continuous Time & Discrete Time: **(08)**

Continuous time & discrete time Fourier series: Trigonometric and Exponential Fourier series and Derivation, properties of Fourier series: linearity, time shifting, frequency shifting, time reversal, time scaling, time differentiation & time integration, multiplication, convolution.

5. Fourier Transform: **(06)**

Concept of Fourier transform on functions: rectangular, impulse, signum. Properties of Fourier transform: linearity, time shifting, frequency scaling, time scaling, multiplication, and Convolution.

6. Z transform: **(04)**

Introduction , need of Z-transform, ROC, properties of ROC, Unilateral Z-transform, properties of Z Transform: linearity, time shifting, time reversal, time scaling, convolution, differentiation, Multiplication, Parsevals theorem,. Inverse Z-transform: PFE Method, long division method,

residue method, convolution method. Transfer function (Poles & Zeros), stability and causality of system in Z transform

- **Reference Books :**

1. Simon Haykin, Barry Van Veen- 'Signals & system' - IInd Edition Wiley publication
2. Michael J. Roberts. -'Fundamentals of signals & systems'- Tata McGraw Hill, 2007.
3. Alan V. Oppenheim, Alan S. Wilsky, S. Hamid Nawab -'Signals & system' -IInd Edition - Pearson Education.
4. H.A HSU, 'Signals & system' (Schaum's out lines), Tata McGraw Hill
5. Smarajit Ghosh, 'Signals & system' Pearson Education.
6. Charles L. Philips, John M. Parr, Eve A. Rislein 'Signals, system & transform', III Edition, Pearson Education.
7. Ramesh Babu 'Signals & system', SciTech Publication.
8. Benoit Boulet 'Fundamentals of signals & System' Thomsan Learning
9. Salivahanan, Vallavaraj, Gnananapriya 'Digital Signal Processing', TMH

- **Term work:**

Term work shall consist of Minimum 08 Tutorials and 08 experiments.

- **List of Experiments :**

1. Generation of CT signals
2. Generation of DT signals
3. Even and odd components of a given signal
4. Convolution of sequences
5. Converting CT Signal to DT using sampling theorem
6. Effect of under sampling and over sampling
7. Reconstruction
8. Fourier transform
9. Z-transform
10. Inverse Z-transform

T.E. (Bio – Medical Engineering) Part II

Biomedical Instrumentation-II

Teaching Scheme:	**Examination Scheme:**
Lectures: 4 hr/week	Theory: 100 Marks
Practical: 2 hr/week	Term Work: 25 Marks
	POE: 50 Marks

Section I

1. Generation of Bioelectric Potentials **(5 Hrs)**

Nerve, Muscle, Pacemaker and Cardiac muscle

2. Biophysical signal capture, processing and recording systems (with technical specifications) **(10 Hrs)**

Typical medical recording system and general design consideration. Sources of noise in low level recording circuits. ECG, EMG, EEG, EOG, ERG. Phonocardiography. Measurement of skin resistance.

3.Patient Monitoring System **(08 Hrs)**

Measurement of Heart Rate, Pulse rate, Blood pressure, Temperature and Respiration rate, Apnea Detector.

Section II

4.Arrhythmia and Ambulatory Monitoring Instruments: **(06 Hrs)**

Cardiac Arrhythmias. Ambulatory monitoring instruments.

5. Foetal and Neonatal Monitoring System: **(06 Hrs)**

Cardiotocograph , Methods of monitoring of Foetal Heart rate and labor activity, Foetal scalp PH measurement, Incubator and Infant warmer.

6. Biotelemetry, Telemedicine concepts and its application **(06 Hrs)**

Working principle, block diagram & medical applications

7. Biofeedback Technique: EEG, EMG **(04 Hrs)**

Working principle, block diagram, clinical analysis & diagnosis

8. Electrical Safety in Biophysical Measurements **(02 Hrs)**

Safety hazards, leakage current, protection & precautions

Term work:
Term work will consist of at least 08 Laboratory Experiments based on the above syllabu. Test and Assignments/Seminars be suitably graded by teachers and attached in the journal.

Text Books:

1. Handbook of Biomedical Engineering By R.S. Khandpur, PHI
2. Medical Instrumentation, Application and Design By J.G. Webster, TMH.
3. Introduction to Biomedical Equipment Technology By Carr.-Brown (Pearson
4. Education Pub)
5. Introduction to Biomedical engineering by J Bronzino

References Books:

1. Encyclopedia of medical devices and instrumentation - J.G. Webster Vol I, II, III, IV (John Willey).

2.Various Instruments Manuals.

3. Principles of applied Biomedical Instrumentation by Geddes and Becker, Wiley inter science publication.

4 Principles of Biomedical Instrumentation and Measurement by Richard Aston

T.E. (Bio – Medical Engineering) Part II

MEDICAL IMAGING- I

Teaching Scheme:
Lectures: 3 hr/week
Tutorial: 1 hr/week

Examination Scheme:
Theory: 100 Marks
OE: 25 Marks

Section I

1. Ultrasound in Medicine **(10 Hrs)**

Introduction, Production and Characteristics of Ultrasound. Display System: A-mode, B-mode and M-mode display and applications. Ultrasound transducers and instrumentation. Real-Time Ultrasound, Continuous wave and Pulsed wave Doppler Ultrasound systems, Color flow imaging, applications. Ultrasound contrast agents and applications.

2. X-ray Imaging **(08 Hrs)**

Properties of X-rays, Production of X-rays, X-ray interaction with Matter, Parts of X-ray machine : X-ray tubes, Rating of X-ray tubes, X-ray generators, X-ray Image and Beam Limiting Devices, Controls, X-ray Film development technique.

Section II

3. Fluoroscopy Imaging and X-ray Image intensifier **(03 Hrs)**

4. Computed Radiography and Digital Radiography **(03 Hrs)**

5. Angiography techniques & its applications **(02 Hrs)**

6. Mammography, Principle, Equipment, Digital Mammography **(03 Hrs)**

7. Medical Thermography: Physics of thermography, thermographic equipment, applications **(04 Hrs)**

8. Endoscopy: Equipment, Imaging and its applications **(03 Hrs)**

Tutorials :

Minimum eight tutorials based on above syllabus.

Text Books:

1. Christensen's Physics of Diagnostic Radiology (Lipimcott William and willkins Publication)
2. Medical Imaging Physics William R. Hendee (Wiley-Liss Publication)

References Books:

1. Biomedical Technology and Devices Handbook by James Moore
   George Zouridakis (CRC Press)
2. Biomedical Engineering Handbook by Bronzino (CRC Press)
3. Physics of Diagnostic Imaging –Dowsett

T.E. (Bio – Medical Engineering) Part II

Biostatistics

Teaching Scheme:
Lectures: 3 hr/week
Practical: 2 hr/week

Examination Scheme:
Theory: 100 Marks
Term Work: 25 Marks

Section I

1. Introduction to biostatistics (03 Hrs)

Basic Concepts, Measurement and Measurement scales, The simple Random Sample, Ordered Array, frequency distribution, Measures of Central tendency, measures of dispersion, Variance and Standard deviation.

2. Probability Distribution (02 Hrs)

Basic Probability concepts, Elementary properties of Probability, Binomial Distribution, Poisson Distribution, Continuous Probability distributions, Normal Distribution with applications

3. Estimation Theory (07 Hrs)

Confidence interval for a population mean, Confidence interval estimates for Population parameters, and various other confidence intervals, t-distribution, applicability to samples from normal distributions, Determination of sample size foe estimating means and for estimating proportions, Confidence interval for the Variance of a normally distributed population

4. Analysis of Variance (06 Hrs)

Purpose of Analysis of variance, Linear Mathematical model for analysis of variance, The completely randomized design, Randomized Complete Block diagram, Repeated measures design, The factorial experiment. Two-factor Experiments with Replication.

Section II

5. Curve fitting, Regression and Correlation (06 Hrs)

Curve fitting, Regression and Correlation Model, Sample regression equation, using regression equation, Correlation coefficient, Multiple Linear regression model, Multiple Linear Correlation model, Obtaining Multiple Linear regression equation, evaluating Multiple Linear regression equation, Regression analysis-Qualitative independent variables, Variable selection procedures

6. Tests of Hypothesis and Significance (05 Hrs)

Statistical decisions, Statistical Hypothesis, Null Hypothesis, Type I and Type II errors, level of significance, One Tailed and Two Tailed tests, Relationship between Estimation theory and Hypothesis testing. Yates' Correction for Continuity

7. **Chi-square Distribution and analysis of frequencies (03 Hrs)**

Mathematical properties of chi-square distribution, Tests of goodness-of-fit, tests Of independence, tests of homogeneity, The fisher exact test

8. **Non-parametric and distribution-free statistics (04 Hrs)**

The sign test, The Wilcoxon signed-rank test for location, The median test, The spearman rank correlation coefficient, Non Parametric Regression Analysis, Classification (differential, diagnosis), sequential clinical trials, and other applications

Term work:

Term work consists of minimum eight practical based on above syllabus using suitable simulation tool like Matlab or other.

Text Books:

1. Ashok Ambardar, Analog and Digital Signal Processing, Thomson Learning Publication, second edition, first reprint, 2001.
2. Proakis and Manolakis ,Digital Signal Processing Pearson
3. Oppenheim & Schafer with Buck, Discrete- Time Signal Processing, Prentice Hall, Signal Processing series, second edition, 2000.
4. S.K Mitra, Digital Signal Processing, Tata McGraw Hill Publication.
5. T.J Cavicchi, Digital Signal Processing, Wiley Publications, 2002

T.E. (Bio – Medical Engineering) Part II
Digital Signal Processing

Teaching Scheme:
Lectures: 4 hr/week
Practical: 2 hr/week

Examination Scheme:
Theory: 100 Marks
Term Work: 25 Marks

Section I

1. The Discrete Fourier Transform **(**10)

Frequency domain sampling ,Reconstruction of Discrete time signals, Discrete Fourier Transform(DFT), DFT as a linear Transformation, Relation between DFT & Z Transform, Properties of DFT, Circular convolution, Circular correlation, Linear Filtering methods based on DFT, Fast convolution techniques Overlap add & overlap save, Frequency analysis of signals using DFT,Discrete Cosine Transform ,Forward DCT,Inverse DCT,DCT as an Orthogonal Transform.

2. Fast Fourier Transform (08)

FFT Algorithm, Radix -2 Decimation in Time-DIT FFT & Decimation in Frequency-DIF FFT, IFFT, Applications of FFT Algorithms, Efficient computation of the DFT of Two Real Sequences, Efficient Computations of a 2N point Real sequence. Use of FFT in Linear Filtering and Correlation.

3. Realization of Digital Linear systems **(**06)

Structures for realization of Discrete time systems, Structures for FIR Filters: Direct form, Cascade form & Lattice Structure, Structures for IIR filters: Direct form, , cascade Structures, parallel form structures

Section II

4. FIR Filter design **(**08)

Characteristics of FIR Filter, Symmetric and Antisymmetric FIR Filters, Design of Linear Phase FIR Filter by using Windows, Frequency Sampling Method, Fourier Series Method.

5. IIR Filter design **(**08)

IIR Filter Design by Impulse Invariant technique, Bilinear transformation, Frequency transformations, Analog filter approximations, Implementation of IIR filters.

6. Adaptive Filters **(**08)

System Identification or System Modeling, Adaptive channel Equalization, Adaptive Line Enhancer, Adaptive Noise Cancelling, Adaptive Direct Form FIR Filters-LMS algorithm

Term work:

Term Work should consist of minimum 10 experiments based on above syllabus.

List of Experiments

Experiments may be performed using Matlab /DSP simulator/DSP Starter kit

1. Generation of DT signals
2. Convolution and correlation of signals
3. Computation of DFT & IDFT using standard formula
4. Computation of DFT using FFT algorithms
5. Computation of circular convolution
6. Design of FIR LPF, HPF, BPF, BRF filter using Fourier series method
7. Design of FIR LPF, HPF, BPF, BRF filter using frequency sampling method
8. Design of FIR filter using Window method
9. Design of IIR LPF, HPF, BPF, BRF filter using impulse invariance method
10. Design of FIR LPF, HPF, BPF, BRF filter using bilinear transformation method
11. Design IIR filter using placement of poles & zeros.
12. Computation of DCT

Reference Books:

1. Digital Signal Processing – Principles, Algorithms and Applications by John G Proakis-Pearson Education.
2. Digital Signal Processing – A Practical Approach by Ifeachor E.C. & Jervis B. W. -Pearson Education.
3. Digital Signal Processing by S Salivahanan, A Vallavaraj & C Gnanapriya -TMH
4. Digital Signal Processing by Ramesh Babu - Scientic Publication
5. Discrete time signal Processing by A.V. Oppenheim & R.W. Schalfer.- John Wiley
6. Digital Signal Processing – A System Design approach by D.J. Defata- John Wiley
7. Digital Signal Processing Fundamentals Applications by Li Tan- Academic Press
8. Digital Signal Processing by M.H.Hayes.-(Schaums Outline) TMH
9. Fundamental of DSP using Matlab by Schilling-Cengage learning

T.E. (Bio – Medical Engineering) Part II

Embedded Systems

Teaching Scheme:
Lectures: 4 hr/week
Practical: 2 hr/week

Examination Scheme:
Theory: 100 Marks
Term Work: 25 Marks
POE: 50 marks

Section I

1. **MCS 51 Microcontroller family** **(10 Hrs)**

Introduction to MCS family, Comparison of microprocessor and microcontroller, Features, Architecture, functional pin description, SFRs, various resources of MCS-51 Hardware Review: Study of Port structure, Interrupt structure, Timer/Counter, Serial port.

2. 8051 Assembly Language Programming **(12Hrs)**

Addressing modes, Instruction set, Assembly Language Programming, CPU timings, 8051A as a Boolean Processor, Power Saving Options, 8051 I/O expansion using 8255, Typical MCS51 based system, Multiprocessor Communication in MCS-51, Interfacing problems

Section II

3. Interfacing of devices with MCS 51 microcontroller **(08 Hrs)**

Switches, LED, Relay, Buzzer, LCD display, Matrix keyboard, ADC0809, DAC 0808, RTC DS1307, Stepper motor

4. Embedded Software **(04 Hrs)**

Introduction to Embedded Systems, Examples of embedded system, their characteristics and their typical hardware components, Software Embedded into a system embedded software architecture, Processor and Memory organization Structural Units in a processor, Processor Selection for an embedded system

5. Memory Selection for Embedded System **(05 Hrs)**

Memory devices, Memory selection for an embedded system, Allocation of Memory to program segments and blocks and memory map of a system, Direct Memory access, Interfacing processor, memories and I/O devices

6. Devices and Buses for Device networks **(05 Hrs)**

I/O devices, Timer and counting devices, Serial Communication using the 'I2C','CAN' and Advanced I/O Buses between the networked multiple Devices, host system or computer parallel communication between the networked I/O Multiple Devices using the PCI, PCI-X and advanced buses

Term work:

Minimum 10 experiments on MCS 51

List of Experiments

1. Programs based on different addressing modes, arithmetic and logical instructions. – 4 Programs
2. Interfacing of Switches, LEDs
3. Interfacing of Matrix keyboard
4. Interfacing of LCD display
5. Interfacing of DAC 0808 and generation of various waveforms
6. Interfacing of ADC 0809
7. Use of timer for generation of time delays
8. Use of timer as Counter
9. Interfacing of Stepper motor
10. Serial Communication

Text Books:

1. The 8051 microcontrollers-Kenneth J Ayala
2. Rajkamal, Embedded systems-architecture, programming and design, Tata McGraw Hill
3. Frank Vahid,Toney Givargi-Embedded System Design: A unified Hardware /Software Introduction John Wiley publication
4. David E. Simon -An Embedded Software Primer Pearson Education

Reference Books:

1. Muhammad A Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education
2. Sriram Iyer and Pankaj Gupta, Embedded Real-time systems programming, Tata McGraw Hill
3. Embedded Microcomputer Systems- Real time Interfacing -Valvano

T.E. (Bio – Medical Engineering) Part II

Mini Project

Teaching Scheme:
Tutorial: 1 hr/week
Practical: 2 hr/week

Examination Scheme:
Term Work : 25 marks

- Mini project should consist of Simple Bio Medical application Design, pre-testing of main blocks in the circuit on breadboard, PCB making and testing of final assembly. Mini Project based on Biomedical Modeling & Simulation & Bio Statistics is also encouraged
- **The total work should include**

1) Collection of appropriate data for main components in the project.
2) Design of circuit including analog part, digital part and suitable power supply.
3) Testing of main circuit blocks on breadboard.
4) Design of PCB layout for above designed circuit
5) Fabrication of PCB & assembly of circuit on PCB.
6) Testing and result analysis of the circuit
7) Suitable cabinet design for the circuit

- **Guidelines for project selection-**

1) Use of microcontrollers is encouraged.
2) Implementation of concepts from subjects studied is encouraged.

- **Note:**

1) A mini project group size should not exceed three students
2) Student should deliver a seminar on mini project