Microcontrollers and Embedded Systems

T.E. Sem. VI [BIOM]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical & Oral Exam	–	–
Oral Exam	–	25
Term Work	–	25

SYLLABUS

1. **Hardware of 8051 Microcontrollers, Intel MCS 51 Family**
   Introduction to Single chip microcontrollers of Intel MCS 51 family. Comparison of microprocessor and microcontroller, architecture and pin functions of 8051 Single chip microcontroller, C.P.U. timing and machine cycles, internal memory organization, Program counter and stack, input/output ports, counters and timers, serial data input and output Interrupts. Connection of external memory. Power saving modes. Interfacing of 8051 with EPROM.

2. **8051 Assembly Language Programming**
   Instruction set addressing modes, immediate, registers, direct and indirect data movement and Exchange instructions, push and pop up-codes, arithmetic and logic instructions, bit level Operations, jump and call instructions, input/output port programming, programming timers Asynchronous serial data communication, timer and hardware interrupt service routines.

3. **Microcontroller Design and Interfacing**
   External memory and memory address decoding, memory mapped I/O, time delay subroutine look up table implementation, interfacing matrix keyboard and seven segment displays through scanning and interrupt driven programs, interfacing ADC and DAC. Interfacing of LCD display.

4. **Embedded Software**
   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, 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.

5. **Devices and Buses for Device Networks**
   I/O devices, Timer and counting devices, Serial Communication using the '12C', '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.

6. **Device Drivers and Interrupts Servicing Mechanism**
   Device drivers, Parallel port device drivers in a system, serial port device Drivers in a system, device drivers for internal programmable timing devices, Interrupt servicing (handling) mechanism, Deadline and Interrupt Latency.4.

Reference :

1. The 8051 microcontrollers (*Kenneth J Ayala*)
2. Embedded systems-architecture, programming and design, (*Rajkamal*) Tata McGraw Hill.
3. Embedded System Design: A unified Hardware/Software Introduction (*Frank Vahid*, *Toney Givargis*) John Wiley Publication.
4. An Embedded Software Primer (*David E. Simon*) Pearson Eduation.
5. The 8051 Microcontroller and Embedded Systems (*Muhammad A Mazidi*) Pearson Education.
6. Embedded Realtime systems programming (*Sriram Iyer and Pankaj Gupta*) Tata McGraw Hill.
7. Embedded Microcomputer Systems Real time Interfacing Valvano

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Medical Imaging - I

T.E. Sem. VI [BIOM]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical & Oral Exam	–	–
Oral Exam	–	25
Term Work	–	25

SYLLABUS

1. **Ultrasound in Medicine**
   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**
   Properties of X-rays, Production of X-rays, X-ray interaction with Matter.
   Total Radiographic System : X-ray tubes, Rating of X-ray tubes.
   X-ray generators, X-ray Image and Beam Limiting Devices, Controls, X-ray Film development technique.

3. Fluoroscopy Imaging and X-ray Image intensifier.

4. Computed Radiography and Digital Radiography

5. Angiography techniques

6. Mammography, Principle, Equipment, Digital Mammography

7. Medical Thermography: Physics of thermography, thermographic equipment, applications.

8. Endoscopy: Equipment, Imaging and its applications

Reference :

1. Christensen's Physics of Diagnostic Radiology Lipimcott William and Willkins Publication.
2. Medical Imaging Physics (*William R. Hendee*) Wiley-Liss Publication.
3. Biomedical Technology and Devices Handbook (*James Moore & George Zouridakis*) CRC Press.
4. Biomedical Engineering Handbook (*Bronzino*) CRC Press.
5. Physics of Diagnostic Imaging - Dowsett

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Biomedical Instrumentation - II

T.E. Sem. VI [BIOM]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical & Oral Exam	2 Hrs.	25
Oral Exam	–	–
Term Work	–	25

SYLLABUS

1. **Generation of Bioelectric Potentials**
   Nerve, Muscle, Pacemaker and Cardiac muscle

2. **Biophysical Signal Capture, Processing and Recording Systems (with technical specifications)**
   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**
   Measurement of Heart Rate, Pulse rate, Blood pressure, Temperature and Respiration rate, Apnea Detector.

4. **Arrhythmia and Ambulatory Monitoring Instruments**
   Cardiac Arrhythmias. Ambulatory monitoring instruments.

5. **Foetal and Neonatal Monitoring System**
   Cardiotocograph, Methods of monitoring of Foetal Heart rate and labour activity, Foetal scalp PH measurement, Incubator and infant warmer.

6. **Biotelemetry, Telemedicine concepts and its application**

7. **Biofeedback Technique: EEG, EMG**

8. **Electrical Safety in Biophysical Measurements**

Reference:

1. Handbook of Biomedical Engineering (*R.S. Khandpur*) PHI.
2. Medical Instrumentation, Application and Design (*J.G. Webster*) TMH.
3. Introduction to Biomedical Equipment Technology (*Carr.-Brown*) Pearson Education Pub.
4. Introduction to biomedical Engineering (*J Bronzino*)
5. Encyclopedia of medical devices and instrumentation (Vol 1 to 4) (*John Willey*) J.G. Webster.
6. Various Instruments Manuals.
7. Principles of applied Biomedical Instrumentation (*Gedded and Becker*) Wiley interscience Publication.
8. Principles of Biomedical Instrumentation and Measurement (*Richard Aston*)

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Biological Modeling and Simulations

T.E. Sem. VI [BIOM]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical & Oral Exam	–	–
Oral Exam	–	25
Term Work	–	25

SYLLABUS

1. **Physiological Modeling**
   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**
   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.

3. **Neuromuscular System**
   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**
   Four eye movements, quantitative eye movement models, validity criteria.

5. **Thermo Regulatory Systems**
   Thermoregulatory mechanisms, model of thermoregulatory system, controller model, validation and application.

6. **Modeling the Immune Response**
   Behavior of the immune system, linearized model of the immune response.

7. Pharmacokinetics Drug delivery

8. Modeling of Insulin Glucose feedback system and Pulsatile Insulin secretion.

Reference:

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 (*Barr and Ploncey*)
4. Biomedical Engineering Handbook (*Bronzino*) (CRC Press).

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Biostatistics

T.E. Sem. VI [BIOM]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical & Oral Exam	–	–
Oral Exam	–	–
Term Work	–	25

SYLLABUS

1. **Introduction to Biostatistics**
   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**
   Basic Probability concepts, Elementary properties of Probability, Bionomial Disribution, Poisson Distribution, Continuous Probability distributions, Normal distribution with applications.

3. **Estimation Theory**
   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 for estimating means and for estimating proportions, Confidence interval for the Variance of a normally distributed population.

4. **Analysis of Variance**
   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.

5. **Curve fitting, Regression and Correlation**
   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**
   Statistical decisions, Stastitical 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**
   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**
   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.

Reference:

1. A Foundation For Analysis in Health Sciences Wiley Series (*Wayne W. Daniel Biostatistics*)
2. Probability and Statistics (*Murray R. Spiegel*) Schaum′s Series.
3. An Introduction to Medical Statistics (*Martin Bland*) Oxford University Press, 1987.

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Digital Signal Processing for Biomedical Applications

T.E. Sem. VI [BIOM]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical & Oral Exam	–	–
Oral Exam	–	–
Term Work	–	25

SYLLABUS

1. **Discrete Time(DT) Signals and Systems**
   Review of Discrete time signals and systems.

2. **Z Transform**
   Review of Z transform, Analysis of LTI systems in Z domain.

3. **Frequency Analysis of DT Signal**
   DTFS definitions from orthogonal complex exponentials, CTFS and DTFS and Properties of DTFS, Power Density Spectrum, DTFT and Properties of DTFT, Energy Density Spectrum.
   Relationship between DTFT and Z transform.

4. **Discrete Fourier Transform (DFT)**
   DTFT, DFT and DFT properties, Block convolution using DFT by Overlap-add and Overlap-save methods, Fast Fourier transform (FFT).

5. **System realization of DT Systems**
   System Transfer function, System realizations using direct, cascade, parallel and Lattice forms.
   System Analysis : Impulse response, zero input and zero state response Signal generation.

6. **Design of Digital Filters**
   Design of FIR filters, Design of IIR filters from analog filters, frequency transformations, Design of digital filters based on least squares method digital filters from analogue filters, Properties of FIR digital filters, Design of FIR filters using windows, Comparison of IIR and FIR filters, and Linear phase filters.
   Application of Filters on Biomedical Signals like ECG, EEG, EMG, Receiver, Advantages, Disadvantages.

7. **DSP Processors**
   Need for Special Architecture, Difference between DSP Processor and microprocessor, general DSP Processor.

Reference:

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

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