Microcontrollers and Embedded Systems
T.E. Sem. VI [BIOM]

EVALUATION SYSTEM

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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.
Reference:
1. The 8051 microcontrollers (*Kenneth J Ayala*)
2. Embedded systems-architecture, programming and design, (*Rajkamal*) Tata McGraw Hill.
5. The 8051 Microcontroller and Embedded Systems (*Muhammad A Mazidi*) Pearson Education.
7. Embedded Microcomputer Systems Real time Interfacing Valvano
Medical Imaging - I
T.E. Sem. VI [BIOM]

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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.
   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:
4. Biomedical Engineering Handbook (Bronzino) CRC Press.
5. Physics of Diagnostic Imaging - Dowsett
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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.
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.
8. Principles of Biomedical Instrumentation and Measurement (Richard Aston)
Biological Modeling and Simulations
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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**

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)
Biostatistics
T.E. Sem. VI [BIOM]

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SYLLABUS

1. **Introduction to Biostatistics**

2. **Probability Distribution**
   Basic Probability concepts, Elementary properties of Probability, Bionomial Distribution, 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**

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*)
Digital Signal Processing for Biomedical Applications
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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**
   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.

6. **Design of Digital 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:
2. Digital Signal Processing (*Proakis and Manolakis*) Pearson