

**BHARATHIAR UNIVERSITY, COIMBATORE-641046**

**M. PHIL / PH.D (FT / PT) – INSTRUMENTATION**

**PART I-SYLLABUS**  
**(with effect from 2008-09 onwards)**

**PAPER III -**

- 1. Computer Based Instrumentation**
- 2. Bio Medical Instrumentation**
- 3. Embedded Systems**
- 4. VLSI System Design**
- 5. MEMS and their application**
- 6. Digital Signal Processing**
- 7. RTOS and Vx Works**

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**M.Phil – Part-I: syllabus**

## PAPER III: COMPUTER BASED INSTRUMENTATION

### **UNIT I: 8051 CORE MICROCONTROLLER**

8051 Core Microcontroller: Introduction-Memory Organization Logical Separation of Program memory and Data memory-Program Memory-Data Memory-Instruction Set-CPU Timing-Interrupt structure.

### **UNIT II: PIC MICROCONTROLLER**

PIC 16F877 Microcontroller: Introduction –Architecture-Pin Out Diagram –Memory Organization-ALU-Status Register-Option Register –INTCON Register-Program Counter –Watch Dog Timer –Sleep Ports Interrupt-Timer-Instruction set.

### **UNIT III:PC HARDWARE**

Special Features Of 286, 386, 486,Pentium Series Processor-Motherboard types and Classification-Memory Mapping –I/O address-RAM Types-I/O Cards-Basic Concepts Of FDD and HDD-I/O Slot-Com port-LPT Port-Interrupt-BIOS-TSR Programs.

### **UNIT IV: INTERFACING CONCEPT**

Input Output Interfacing-Practical Interface Considerations-Logical level –Serial drive – Capacities –Driving heavy Loads –Driving AC Loads-Serial Format-Asynchronous/Synchronous Serial Data Communication-MODEM –Parallel/Serial Interface.Interfacing Keyboard –Interfacing Alphanumeric Display-Interfacing ADC-interfacing DAC-Interfacing LCD Module-Interfacing Stepper Motor-Temperature Monitoring –design of 8255 card for PC-Optical Motor Shaft Encoder.

### **UNIT V: COMPUTER –BASED CONTROLLER**

Introduction- Computer-Based Controller-Hardware Configuration, Software Requirements-Other Computer applications –Data Logging, Supervisory Control –Control system Networks-Development, General Characteristics, field Bus Types.

### **REFERENCE BOOKS**

UNIT I: 1.Intel Manual Embedded Microcontroller

2. Ayala K.J.-The 8051 Microcontroller Architecture Programming and Applications -3<sup>rd</sup> Edition-Penram International.

3.Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D.McKinlay, The 8085 Microcontroller and Embedded systems, using Assembly and C,2nd Edition Prentice Hall, 2008

UNIT II: 1.PIC 16F877 DATA Sheet

2. PIC Micro Mid Range MCU Family Reference Manual.

UNIT III: 1.Stephan J.Bigelow-Trouble Shooting, Maintaining & Repairing PC's-Tata McGraw Hill, 2nd Edition.

2. B.Govindarajalu-IBM PC and Clones Hardware Troubleshooting and Maintenance-Tata McGraw Hill.

3. Peter Norton –Inside IBM PC and PS/2-4th edition, Prentice Hall of India.

UNIT IV: 1.Ronald J.Tocci, Leots P.Laskowski-Microprocessor and microcomputer Hardware and Software-Prentic Hall of India.

UNIT V: 1.Douhgles V.Hall-Microprocessor and Interfacing Programming and Hardware-Tata McGraw Hill.

2. Ramesh S.Goankar--Microprocessor and Interfacing Programming and Application With 8085/8080A –3<sup>rd</sup>-Edition- Wiley Eastern Limited.

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**PAPER III: BIO-MEDICAL INSTRUMENTATION**

**UNIT I: PHSYIOLOGY AND TRANSDUCERS**

Cell and its structure-Action and resting-Potential propagation of action potential-Sodium pump-Nervous system-CNS-PNS –Nerve cell-Synapse-Cardio pulmonary system-Physiology of heart and lungs Circulation and respiration-Transducers-Different types-Piezo-electric, ultrasonic, resistive, capacitive, inductive transducers-Selection criteria

**UNIT II:ELECTRO-PHYSIOLOGICAL MEASUREMENTS**

Basic components of biomedical system-Electrodes-Micro, needle and surface electrodes-amplifiers-Preamplifiers, differential amplifiers, chopper amplifiers-isolation amplifier.ECG-EEG-EMG-ERG-Lead systems and recording methods-Typical waveforms.

**UNIT III:NON-ELECTRICAL PARAMETER MEASUREMENTS**

Measurement of blood pressure-Cardiac output-Cardiac rate-Heart sound-Respiratory rate-Gas volume-Flow rate of CO<sub>2</sub>,O<sub>2</sub> in exhaust air-pH of blood, ESR, GSR measurements-Plethysmography

**UNIT IV:MEDICAL INSTRUMENTATION**

X-ray machine-Radio graphic and fluoroscopic techniques-Computer tomography-MRI – Ultrasonography-Endoscopy-Thermography-Different types of biotelemetry systems and patient monitoring-Electrical safety.

**UNIT V:ASSISTING AND THERAPEUTIC EQUIPMENTS**

Pace makers-Defibrillators-Ventilators-Nerve and muscle stimulators-Diathermy-Heart-Lung machine-Audio meters-Dializers.

**TEXT BOOKS**

- 1.Leslie Cromwell, Fred J.Weibell,Erich A.Pfeiffer,"Bio-Medical Instrumentation and Measurements" II edition, Pearson Education,2002/PHI
- 2.R.S.Khandpur,"Handbook of Bio-Medical Instrumentation"Tata Mc Graw Hill Publishing Co.Ltd.2003.

**REFERENCE BOOKS**

- 1.M.Arumugam,Bio-Medical Instrumentation,"Anuradha Agencies,2—3.
- 2.L.A.Geddes and L.E.Baker,"Principles of Applied Bio-Medical Instrumentation" John Wiley & Sons 1975.

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**PAPER III: EMBEDDED SYSTEMS**

**UNIT I: INTRODUCTION TO EMBEDDED SYSTEMS**

Introduction – Features – microprocessors – ALU - Von Neumann and Harvard Architecture – CISC and RISC - Instruction pipelining ,Microcontroller: characteristics and Features, Controller overview and architecture – PIC 16F 84 – Philips80C552 – Motorola 68HC05/08, Examples of Embedded Systems: Telegraph and Bar coded scanner

**UNIT II: PIC MICROCONTROLLERS**

PIC Microcontrollers: CPU Architecture and Instruction Set –External Interrupts—Timers I/O port Expansion—analog to Digital Converter –UART -I<sup>2</sup>C Bus for Peripheral Chip Accessories—Special Features.

**UNIT III: MC68HCXX—MOTOROLA MICROCONTROLLERS**

MC68HC05: Architecture – Registers—Addressing Modes –MC68HC08:Introduction Memory Map Registers—Addressing modes-- MCHC11:INTRODUCTION—Expanded Modes—Registers - Addressing modes—Erasing and Programing-MC68HC11: EEPROM, MC68HC12: Architecture--Expanded Modes Registers - Addressing modes.

**UNIT IV: SOFTWARE ARCHITECTURE AND RTOS**

Soft ware Architecture: Round Robin--: Round Robin with interrupts—Function Queue. Scheduling Architecture RTOS: Architecture—Tasks and Task States—Tasks and Data—Semaphores and Shared Data—Message Queues—Mail Boxes and pipes—Timer Functions—Events—Memory Management Interrupt Routines.

**UNIT V: SOFTWARE DEVELOPMENT TOOLS AND DEBUGGING TECHNIQUES**

Development Tool: Cross Compiler—Cross Compiler –Cross Assemblers –Linker / locator PROM Programmers – ROM Emulator –In Circuit Emulators—Debugging Techniques: Software Techniques on Development –Host—Simulators—The Assert Macro –Laboratory Tools.

**TEXT BOOKS/REFERENCES:**

1. Rajkamal – Embedded Systems Architecture, Programming and Design, TMH, 2008
2. Tim wilmshurst—An Introduction to Design of Small Scale Embedded systems—Pal grave Publications.
3. John B.Peatman Design with P/C Microcontrollers—Pearson Education.
4. Johnathan. w.valvano –Embedded Microcomputer Systems, real time interfacing-Brooks/ Cole, 2000.
5. David E.Simon –An Embedded Software Primer Pearson Education, 1999.

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**PAPER III: VLSI SYSTEM DESIGN**

**UNIT I**

VLSI technology- NMOS, CMOS and BICMOS circuit fabrication. Layout design rules. Stick diagram. Latch up.

**UNIT II**

System design using HDL- circuit and system representation. Hierarchical representation of digital system. An overview of Verilog. Basics of verilog, operators, hierarchy, procedures and assignments. Timing controls, delay, tasks and functions. Control statements. Test benches.

**UNIT III**

VLSI logic circuits and analysis- MOS and CMOS switches. Implementation of logic circuits using MOS and CMOS technology, multiplexers and memory, MOS transistors, threshold voltage, MOS device design equations. MOS models, small-signal AC analysis. CMOS inverters, propagation delay of inverters, power dissipation.

**UNIT IV**

Programmable logic devices- antifuse, EPROM and SRAM techniques. Programmable logic cells. Programmable inversion and expander logic. Design flow for VLSI circuits. Computation of interconnect delay.

**UNIT V**

VLSI testing -need for testing , manufacturing test principles, design strategies for test, chip level and system level test techniques.

**REFERENCE BOOKS**

N.H.E.Weste etal, CMOS VLSI design, (3/e), Pearson , 2005  
J. Smith, Application Specific Integrated Circuits, Addison Wesley, 1997.  
Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2002.

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**PAPER III: MEMS AND THEIR APPLICATION**

**UNIT I: OVERVIEW OF MEMS & MICRO SYSTEM**

MEMS & Micro systems - typical MEMS & Micro system products – Evaluation of Micro fabrication – Microsystems and Microelectronics –The Multidisciplinary nature of Micro Systems design and Manufacture –Micro Systems and miniaturization – applications of Micro Systems in Automotive industry – applications of Microsystems in other industries.

**UNIT II: WORKING PRINCIPLES OF MICROSYSTEMS**

Micro sensors – Micro actuation using Thermal Forces – Actuation Using shape memory Alloys – Actuation Using Piezoelectric crystals – Actuation using Electrostatic forces – MEMS with Micro Actuators – Micro Accelerometers – Micro Fluidics.

**UNIT III: MATERIALS FOR MEMS AND MICROSYSTEMS**

Introduction- Substrates and Wafers- Active Substrate Materials – silicon as a substrate Material – Silicon Compounds- Silicon Piezoresistors – Gallium Arsenide – Quarts –Piezoelectric Crystals- Polymers- Packaging Materials.

**UNIT IV: MICROSYSTEMS FABRICATION PROCESSES**

Introduction- Photolithography – Ion Implantation – Diffusion – Oxidation – chemical Vapour Deposition – Physical Vapour Deposition – Sputtering- Deposition by Epitaxy – Etching – Summary of Micro fabrication.

**OVERVIEW OF MICROMANUFACTURING:**

Introduction – Bulk manufacturing – Surface Manufacturing- The LIGA Process Summary of Micro manufacturing.

**UNIT V : MICROSYSTEMS DESIGN**

Introduction – Design considerations – Process Design – Photolithography – Thin Film Fabrications – Geometry Shaping – Mechanical Design – Mechanical design using Finite Element Method Design of a Silicon Die for Micro pressure sensor – Design of Micro fluidic Network systems – Design case – Computer Aided Design.

**MICROSYSTEM PACKAGING**

Micro Systems Packaging (Types) – Essential Packaging Technologies (Types)

**REFERENCE BOOKS :**

Tai Ran Hus – MEMS & Micro systems Design and Manufacture – Tata McGraw Hill.

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**PAPER III: DIGITAL SIGNAL PROCESSING**

**UNIT I: INTRODUCTION**

Classification of systems: Continuous, discrete, linear, casual stable, dynamic, recursive, time variance, classification of signals: continuous and discrete, energy and power, mathematical representation of signals: spectral density, sampling technique, quantization, quantization error, Nyquist rate, aliasing effect

**UNIT II: DISCRETE FOURIER TRANSFORM & COMPUTATION**

DFT properties, magnitude and phase representation – computation of DFT using FFT algorithm – DIT & DIF –FFT using radix 2 – Butterfly structure

**UNIT III: FFT**

Introduction of DFT – Efficient Computation of DFT – Properties of DFT – FFT algorithms – Radix – FFT algorithm – Decimation in Time – Decimation in Frequency algorithms – Use of FFT-algorithms in Linear Filtering and correlation.

**UNIT IV: DIGITAL FILTERS DESIGN**

amplitude and phase response of fir filters – linear phase filters – windowing techniques for design of linear phase FIR filters – rectangular, Hanning, Kaiser windows – Frequency sampling techniques – IIR Filters – magnitude response – Phase response – group delay – Design of Low Pass Butterworth filters(low pass)- Bilinear transform – Prewarping.impulse invariant transformation

**UNIT V: DIGITAL SIGNAL PROCESSORS**

Introduction to DSP architecture – Harvard architecture- Dedicated MAC unit – Multiple ALUS, Advanced addressing modes, pipelining, Overview of instruction set of TMS320CSX and C54X

**TEXT BOOKS**

1. J.G.Proakis and D.G.Manollakis,"Digital Signal Processing Principles. Algorithms and Applications" Pearson education, New Delhi 2003/PHI.
2. S.K.Mitra, Digital Signal Processing – A Computer Based Approach Tata Mc Graw Hill, New Delhi, 2001.

**REFERENCE BOOKS**

1. Alan V.Oppenheim, Ronald W.Schafer and John R.Buck,"Discrete-Time Signal Processing" Pearson Education, New Delhi, 2003.
- 2.B.Venkataramani, M.Baskar,"Digital Signal Processors, Architecture, Programming and Applications"Tata Mc Graw Hill, New Delhi, 2003.
- 3.S.Salivahanan, A.Vallavaraj, C.Gnanapriya, Digital Signal Processing'Tata McGraw Hill, New Delhi, 2003.
4. Texas TMS 320C54X user manual (website)
5. J.R.Jhonson, Introduction to Digital Signal Processing Prentice Hall of India, 1989.

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**PAPER III: RTOS AND Vx: WORKS**

**UNIT I: REAL TIME OS-OVERVIEW**

Introduction to Operating System – Functions of Operating System – Types of Operating Systems – Memory Management – Static and Dynamic partitions using MFT and MVT algorithms – Swapping, paging, segmentation – paged segmentations

**Unit II: FILE MANAGEMENT SYSTEM OF OS**

File systems – File structure – Disk structure – File allocation – contiguous and non contiguous allocation – free space management – disk scheduling algorithms – Process management Process - Threads – tasks – PCB –TSB – Process, status, short term – medium term – long term schedulers – CPU scheduling – algorithms – introduction to intel process communication using shared memory – pipes – message ques – semaphore – signal interrupt sockets – introduction to RTOS – real time systems – Hard real time systems – soft real time systems – micro knernel and Monolithic kernel architecture – features of RTOS- overview of some RTOS – LIKE Vx works,QNX,RT Linux,Window Ce,Symbian, Psos.

**Unit III: Vx WORKS, MEMORY MANAGEMENT**

Vx works and Tornado, Features of IDE – Host Target Architecture – Project Management – Thread Scheduling algorithm – Inter task communication using shared memory – Pipes – Message Querres – Semaphores – Mutual exclusion

**Unit IV: FILE FORMATS OF Vx WORKS**

Hardware and software interrupt handling – RAM Disk – File systems – Using DOS file systems on RAM disks – I/O systems – Memory Management – WDT – Message logging – Overview of networking on Vx Works – Managing host table – Managing IP

**Unit V: SOCKET PROGRAMMING**

Address – Sockets – Accessing remote files using FTP, TFTP, RSH and NSF – configuring Vx Works as FTP server and FTP client – TFTP server and client – NFS server and NFS client – NFS Client Rlogin – Using Crosswind for Debugging – Using Wind View as a Runtime Analyzer – Using Browser and Winds, Using Integrated Simulator – Building Vx Works image – Creating a Boot image – Download and Booting Vx Works on the Target system

Reference Books:

1. LIU – Real time systems – Pearson Education
2. Lante – Real time system design and analysis – PHI
3. Vx Works – [www.tornado.com](http://www.tornado.com)

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