MTE 8103 Microprocessor based Systems

Course Description:

The course provides students with an understanding of microprocessor-based systems and their use in instrumentation, control and communication systems.

AIM:

On successful completion of this unit, students should be able, at threshold level, to:

- Investigate microprocessor-based systems.
- Produce software for a microprocessor-based system
- Interface microprocessor-based systems

Detailed Course Content:

Introduction and Historical Perspectives

- Architecture basics, Complex Instruction Set Computers (CISC) and Reduced Instruction Set Computers (RISC) processors, Advantages and Drawbacks of CISC & RISC, Logical Similarity with example of a typical microprocessor,
- Short Chronology of Microprocessor Development with reference to CISC families such as INTEL, AMD and MOTOROLA, RISC families development of POWER PC, Alpha, Sparc

Microprocessor and Microprocessors:

- Specifications, 89C51, and variants, Generation of addresses, data and control buses, selection of proper buffers, loading considerations, clock circuits and power on reset design, Technologies and comparison of Intel 8 to 32 bit Microprocessor and Microcontroller, Special features of microcontrollers.

Fundamental Architectures:

- Defining a Computer Architecture e.g. degree of pipelining, basic topology, technology used etc.,
- Von Neumann and Haward Architectures, Single Processor Systems, Parallelism Implementation using pipelines and multiple units, Superpipelining, Superscalar,
- Very Long Instruction Word (VLIW) architectures, Building multithreaded processors,

System Design:

- Minimum system with 89C51 to monitor frequency, voltage, displacement, liquid level, weight, speed, traffic light control system with s/W development for above.
- Isolation Techniques: Various realys, opto-couplers and their specifications, Interfacing of Relays and opto-couplers, isolation methods for heavy and a.c. loads
- Signal Transmission: V to I and I to V Conversion, V to F and F to V Conversion, netic and Electrostatic Shielding and Grounding.

System design for Control Applications:

- Transducers for temperature, pressure and speed and interfacing them to signal conditioners, Instrumentation Amplifiers for thermocouple, bridge and LVDT,
- System design with 89C51 for measurement and control of temperature, pressure, speed using ON/OFF, Proportional and PID modes, stability aspects of the system, s/w development for above.

ARM processor Architecture:

- Introduction to ARM processor and its important features, and Architecture Programming model, Processor Operating State, Memory Formats,
- Instruction, Length, Data Types, Operating Modes, Exceptions and Interrupts Latencies and Reset.

Introduction to AVR, Architecture and Hardware Resources of AVR Microcontrollers.

- Architecture: The Arithmetic Logic Unit, Program and Data Memories, Downloadable Flash Program Memory, SRAM Data Memory, General-Purpose Register File, I/O Register, EEPROM Data Memory, Peripherals, Timer/Counter, Watchdog Timer, Serial Peripheral Interface SPI, Universal Asynchronous Receiver and Transmitter, Analog Comparator, I/O Ports, Reset and Interrupt System, Interrupt Vector Table, Reset Sources, Clock, Handling the Hardware Resources
- Development Tools: ATMEL AVR Assembler and Simulator, ATMEL AVR Studio.

Multiple Processor Systems

- SIMD, MIMD and multi-computer approaches.
- Implementation Considerations: Memory Hierarchy, prefetching techniques, coherent caches, pipelining, ternary logic, packaging considerations, wafer scale integration.

Implementation of Functional Units:

- Memory Management, Arithmetic Logic Unit, Floating Point Unit, Branch Unit, Vector Unit, Load/Store Unit.
- Development Tools: Microcomputer Development Systems (MDS), In Circuit Emulator (ICE), Assembler, Editors, Logic Analyser.
- Case Study of INTEL x86 family: Overview and Features in brief.

Teaching and Learning Pattern

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students' understanding of the problem based learning techniques.

Assessment method

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:

[1] Wakerley, *Digital Design, Principles & Practice*, 3rd Edition, Prentice Hall 2000.
[2] Miller, *Microcomputer Engineering*, 2nd Edition, Prentice Hall 1999.
[3] Cady, *Software and Hardware Engineering: Motorola M68HC11*, Oxford 1997.
[4] Patterson & Hennessy, *Computer Organization & Design*, 2nd Edition Morgan Kaufmann 1998.
[5] Smith and Franzon, *Verilog Styles for the Sythesis of Digital Systems*, Prentice Hall, 2000
[6] Suprata Ghoshal "Microprocessor based system design", Mac Millan Publishers
[7] John Freer Systems Design with advanced Microprocessors, Wheeler Publishing, Allahabad
[8] Michael Slater 2. Microprocessor Based Design, PHI, New Delhi

[9] John Paul Shen and Mikko H Lipasti, "Modern processor deisgn, Fundamentals of super scalar processors", TMH, New Delhi