

## Introduction to Embedded Processors

| Course Code | L:T:P:S | Credits | Exam marks    | Exam Duration | Course Type |
|-------------|---------|---------|---------------|---------------|-------------|
| 18CSI441    | 3:0:2:0 | 4       | CIE:50 SEE:50 | 3 Hours       | FC          |

### Course Objectives:

This course will enable students to:

- Understand the basics of 8086 microprocessor family and features
- Learn 8086 instruction sets as needed to solve programming problems
- Analyze how 8086 responds to interrupts, how interrupts-service procedures are written and how peripheral devices operate
- Expose architecture of 8086 microprocessor and ARM processor
- Familiarize instruction set of ARM processor

### Syllabus

#### Module - I

**The x86 microprocessor:** Microprocessor Evolution, Main features of 8086, 8086 Pin Diagram/Description, 8086 Internal Architecture, Introduction to Programming the 8086

**07 Hours**

#### Module - II

**8086 Assembly Language Programming:** Data Transfer Instructions, Arithmetic Instructions, Bit Manipulation Instructions, String Instructions, Program Execution transfer Instructions, Processor Control Instructions

**09 Hours**

#### Module - III

**Interrupts and Interfacing:** 8086 Interrupts and Interrupt Responses, 8259A Priority Interrupt Controller, Programmable Parallel Ports and Handshake Input/Output: Methods of Parallel Data Transfer, 8255A Internal Block Diagram and System Connections, Constructing and Sending 8255A Control Words

**08 Hours**

#### Module - IV

**Microcontrollers, ARM Embedded Systems:** Introduction to Microcontrollers, Microprocessors versus Microcontrollers, The RISC Design Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software

**07 Hours**

#### Module - V

**ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and the Vector Table, Introduction to ARM Instruction Set: Data Processing Instructions Simple programming exercises.

**09 Hours**

## **LABORATORY PROGRAMS**

### **SOFTWARE PROGRAMS: PART A**

1. Design and develop an assembly program to sort a given set of 'n' 16-bit numbers in ascending order. Adopt Bubble Sort algorithm to sort given elements.
2. Develop an assembly language program to reverse a given string and verify whether it is a palindrome or not. Display the appropriate message.
3. Develop an assembly language program to compute  $nCr$  using recursive procedure. Assume that 'n' and 'r' are non-negative integers.
4. Design and develop an assembly language program to read the current time and Date from the system and display it in the standard format on the screen.
5. To write and simulate ARM assembly language programs for data transfer, arithmetic and logical operations (Demonstrate with the help of a suitable program).
6. To write and simulate C Programs for ARM microprocessor using KEIL (Demonstrate with the help of a suitable program)

**Note: To use KEIL one may refer the book: Insider's Guide to the ARM7 based microcontrollers, Hitex Ltd.,1st edition, 2005**

### **HARDWARE PROGRAMS: PART B**

7. Design and develop an assembly program to read the status of two 8-bit inputs (X & Y) from the Logic Controller Interface and display  $X*Y$ .
8. Design and develop an assembly program to display messages "FIRE" and "HELP" alternately with flickering effects on a 7-segment display interface for a suitable period of time. Ensure a flashing rate that makes it easy to read both the messages
9. Design and develop an assembly program to drive a Stepper Motor interface and rotate the motor in specified direction (clockwise or counter-clockwise) by N steps (Direction and N are specified by the examiner).
10. Design and develop an assembly language program to a. Generate the Sine Wave using DAC interface (The output of the DAC is to be displayed on the CRO).

**Course Outcomes:**

On completion of this course, the students are able to:

- Discuss microprocessor evolution and 8086 internal architecture
- Describe functions of different types of 8086 assembly language instructions and use assembly language program to solve simple problems
- Explain 8086 interrupt types and their applications
- Differentiate between microprocessors and microcontrollers
- Gain the knowledge for interfacing various devices to x86 family and ARM processor

**Text Books:**

1. Douglas V Hall: “Microprocessors and Interfacing”, (Chapters 1,2,3,6,9,10), TMH, New Delhi, Third Edition, 2012, ISBN(13):9781259006159
2. Andrew N Sloss, Dominic Symes and Chris Wright: “ARM System Developers Guide”, Elsevier, Morgan Kaufman publishers, 2017, Indian Reprint ISBN:9781259006159

**Reference Books:**

1. Barry B Brey: “The Intel Microprocessors”, Pearson Education, New Delhi, 8<sup>th</sup> Edition, 2009, ISBN(13):978-8131726228.
2. K. Udaya Kumar & B.S. Umashankar: “Advanced Microprocessors & IBM-PC Assembly Language Programming”, TMH, 2003.
3. Joseph Yiu: “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes, 2009
4. The Insider’s Guide to the ARM7 based microcontrollers, Hitex Ltd. 1<sup>st</sup> edition, 2005
5. ARM System-on-Chip Architecture, Steve Furber, Second Edition, Pearson, 2015
6. Lyla B Das: “Architecture, Programming and Interfacing of Low power Processors- ARM7, Cortex-M and MSP430”, Cengage Learning, 1<sup>st</sup> edition

**E-Resources:**

1. <http://www.nptel.ac.in/downloads/106108100/>
2. <https://www.google.co.in/search?tbo=pandtbn=bksandq=inauthor:%22Douglas+V.+Hall%22>
3. <https://www.google.co.in/search?tbo=pandtbn=bksandq=inauthor:%22Douglas+V.+Hall%22#tbn=bksandq=Bary+b+brey>
4. [http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/pdf/Teacher\\_Slides/mod1/M1L3.pdf](http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/pdf/Teacher_Slides/mod1/M1L3.pdf)
5. <http://www.nptel.ac.in/downloads/106108100/>
6. <https://www.google.co.in/search?tbo=pandtbn=bksandq=inauthor:%22Douglas+V.+Hall%22>
7. <https://www.google.co.in/search?tbo=pandtbn=bksandq=inauthor:%22Douglas+V.+Hall%22#tbn=bksandq=Bary+b+brey>
8. [http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/pdf/Teacher\\_Slides/mod1/M1L3.pdf](http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/pdf/Teacher_Slides/mod1/M1L3.pdf)

