# PROCESSOR ARCHITECTURE AND INTERFACING

## UNIT – I INTRODUCTION TO ASSEMBLY LANGUAGE PROGRAMMING & 80386PROCESSOR

Introduction to assembly language programming, ALP tools- Assembler, Linker, Loader, Debugger, Emulator, Assembler directives, Far and near procedure, Macros, DOS Internals, DOS Calls, 80386 and - Features and Architecture, Register Set, 80386 Real mode segmentation and Address translation Addressing modes, Instruction set.

## UNIT – II 80386 MEMORY MANAGEMENT
Pin Description of 80386, 16/32-bit data transfer mechanism, Pipelined & Non pipelined bus cycles.Segmentation - support registers and Data structures, Descriptors, Memory management throughsegmentation, Logical to linear/physical address translation.
Privileged instructions, Protection in segmentation, Inter-privilege level transfer using Call gatesandconfirming code segment.

## UNIT – III 80386 – PRIVILEGE PROTECTION, MULTITASKING & INTERRUPTS, EXCEPTIONS

Paging - support registers and Data structures, Descriptors, Linear to physical address translation, Page level protection.
Multitasking - Support registers and Data structures, Descriptors, Task switching.
Real and Protected mode Interrupt structure - IVT, IDT, Type of exceptions and Processing.

## UNIT – IV INTRODUCTION TO 8051 MSP430 MICROCONTROLLER
Difference between microprocessor and microcontroller,16-bit low power MSP430 microcontroller - Features, Architecture, Pin Description. On-Chip data memory and program memory organization - Register set, Register bank and Special Function Registers (SFRs). Addressing modes, Instruction set. External data memory and program memory organization.

## UNIT – V PORTS, INTERRUPTS & TIMERS/COUNTERS OF  MSP430

I/O ports programming ,Programming System registers,  pull up/down registers concepts, Interrupts and Interrupt programming - Structure and Response, Related SFRs and Configuration.
Timers/counters programming - Structure, Related SFRs, Operating modes, Configuration, Low Power aspects of MSP430: low power modes
Serial port programming - Related SFRs, Operating modes, Baud rate calculation and Configuration, Implementing and programming UART, I2C, SPI interface using MSP430.

**UNIT - VI EMBEDDED NETWORKING USING MSP430 AND INTERNET OF TH**

IoT overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC (e.g., RF430CL330H, RF430CL331H, RF430FRL15xH), ZigBee (e.g. CC2538), Bluetooth (e.g., CC256x), Bluetooth Low Energy (e.g., CC2640), Wi-Fi (e.g. CC3100). Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi (e.g., CC3200), User APIs for Wireless and Networking applications, Building IoT applications using CC3100 user API for connecting sensors

**Text Books**

1. James Turley, "Advanced 80386 Programming Techniques", McGraw Hill Education.
2. M. A. Mazidi, J. G. Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education

3.Getting Started with the MSP430 Launchpad by Adrian Fernandez, Dung Dang, Newness publication ISBN-13: 978-0124115880

4.MSP430 microcontroller basics 1st Edition by John H. Davies (Author), Newnes Publication ISBN-   13: 978-0750682763

5.Ajay V. Deshmukh, "Microcontrollers, Theory and applications", Tata McGraw-Hill Companies – 2005

6.A.K.Ray and Bhurchandi, "Advanced Microprocessors and Peripherals", 2nd Edition, TMH Publications.

**Reference Books**

1. Walter A. Tribel, Avtar Singh, "The 8088 and 8086 Microprocessors", 4th edition, Prentice

Hall  of India
2. Ray Duncan, "Advanced MS DOS Programming", 2nd edition, BPB Publications
3. Peter Abel, NiyazNizamuddin, "IBM PC Assembly Language and Programming", Pearson Education
4. Kenneth Ayala ,"The 8051 Micro Controller", 3rd edition, Delmar Cengage Learning
5. I. Scott MacKenzie, Raphael C.-W. Phan, "8051 Microcontroller", 4th edition, Pearson Education
6. Joshi, "Processor Architecture and Interfacing", Wiley, ISBN-9788126545605

7.Douglas V. Hall, "Microprocessors and Interfacing", 2nd Revised Edition, TMH Publications.

8.Liu & Gibson, "Microcomputer Systems: The 8086/8088 Family: Architecture, Programming and Design", 2nd ed., PHI

9.Krishna Kant, "Microprocessors and Microcontrollers", PHI Publishers

**Other References:**

1. http://processors.wiki.ti.com/index.php/MSP430_LaunchPad_Low_Power_Mode
2. http://processors.wiki.ti.com/index.php/MSP430_16-Bit_Ultra-Low_Power_MCU_Training
3. RF430CL330H :
   - Datasheet: http://www.ti.com/lit/ds/symlink/rf430cl330h.pdf
4. RF430CL331H:
   - Datasheet: http://www.ti.com/lit/ds/symlink/rf430cl331h.pdf
5. Datasheet: RF430FRL15xH:
   - Datasheet: http://www.ti.com/lit/ds/symlink/rf430frl152h.pdf
   - User Guide: http://www.ti.com/lit/ug/slau506/slau506.pdf
6. CC2538:
   - Datasheet: http://www.ti.com/lit/ds/symlink/cc2538.pdf
7. CC256x:
   - Datasheet: http://www.ti.com/lit/ds/symlink/cc2560.pdf
8. CC2640:
   - Datasheet: http://www.ti.com/lit/ds/symlink/cc2640.pdf
   - User Guide: http://www.ti.com/lit/ug/swcu117f/swcu117f.pdf
9. CC3100 and CC3200: http://www.ti.com/lit/ug/swru368a/swru368a.pdf

**Processor Interfacing Laboratory**

**Group A: Microprocessor Programming**

1. Write Assembly Language Program (ALP) to add array of N numbers stored in the memory.

2. Write menu driven ALP to convert 4-digit Hex number into its equivalent BCD number and 5-digit
BCD number into its equivalent HEX number. Make your program user friendly to accept the choice
from user for
i. HEX to BCD ii. BCD to HEX iii. EXIT.
Display proper strings to prompt the user while accepting the input and displaying the result. Write
near procedures to complete the task.

3. Write ALP to perform following operation on string:
i. Find and display length
ii. Display reverse
iii. Check whether string is palindrome or not.
Display proper strings to prompt the user while accepting the input and displaying the result. Write
near procedures to complete the task.

4. Write menu driven ALP to perform string manipulations. The strings to be accepted from the
user is to be stored in code segment Module_1 and write FAR PROCEDURES in code segment
Module_2 to perform any two of the following string operations:
i. Concatenation of two strings.
ii. Comparison of two strings.

iii. Finding Number of occurrences of a sub-string in the given string

iv. Finding number of alphabets, digits, special characters, lower & upper case alphabets, words and number of lines from the text.

Note: Use PUBLIC and EXTERN directives. Create .OBJ files of both the modules and link them to create an .EXE file.

**Group B: Microcontroller Programming**
**Embedded C Experiments using MSP430:**

1. Learn and understand how to configure MSP-EXP430G2 Launchpad digital I/O pins. Write a C program for configuration of GPIO ports for MSP430 (blinking LEDs, push buttons interface).

**Exercises:**

    a) Modify the delay with which the LED blinks.
    b) Modify the code to make the green LED blink.
    c) Modify the code to make the green and red LEDs blink:

       i. Together

       ii. Alternately

    d) Alter the code to turn the LED ON when the button is pressed and OFF when it is released.

    e). Alter the code to make the green LED stay ON for around 1 second every time the button is pressed.

    f). Alter the code to turn the red LED ON when the button is pressed and the green LED ON when the button is released.

2. Usage of Low Power Modes:
Configure the MSP-EXP430G2 Launchpad for Low Power Mode (LPM3) and measure current consumption both in active and low power modes. Use MSPEXP430FR5969 as hardware platform and measure active mode and standby mode current.

    **Exercises:**

    a) How many Low power modes are supported by the MSP430G2553 platform?

    b) Measure the Active and Standby Current consumption in LPM3 mode for the same application using MSP430F5529 LaunchPad

3. Learn and understand GPIO based Interrupt programming. Write a C program and associated GPIO ISR using interrupt programming technique.
**Exercises:**
a) Write the code to enable a Timer interrupt for the pin P1.1.

    b) Write the code to turn on interrupts globally

4. Implement Pulse Width Modulation to control the brightness of the on-board, green LED. This experiment will help you to learn and understand the configuration of PWM and Timer peripherals of the MSP430G2553.
   **Exercises:**
   a) Observe the PWM waveform on a particular pin using CRO.
   b) What is the maximum resolution of PWM circuitry in MSP430G2 Launchpad?
   c) Change the above code to create a PWM signal of 75% duty cycle on particular PWM pin.

5. Learn and understand how to configure the PWM and ADC modules of the MSP-EXP430G2 Launchpad to control the DC motor using external analog input.
   **Exercises:**

   a) What is the maximum resolution of PWM circuitry in MSP430G2 LaunchPad and how it can be achieved using program?
   b) Create a PWM signal of 75% duty cycle on particular PWM pin.
   c) Create Switch case code from the example code to run the DC Motor in 3 set of speeds.

6. Configure of Universal Serial Communication Interface (USCI) module of MSP430G2553 for UART based serial communication. The main objective of this experiment is to use UART of the MSP430G2553 to communicate with the computer.
   **Exercise:**

   Modify the above code to transmit the set of strings to the serial terminal via UART as shown below:

   **char str1[]="MSP430G2 launchpad"**

   **char str2[]= "Ultra low power mixed signal processing applications"**

7. Understand and Configure 2 MSP430F5529 Launchpad in master-slave communication mode for SPI protocol.
   **Exercises:**

   a) Which port pins of MSP430 can be configured for SPI communication?

   b) What is the data transfer rate supported by MSP430 for SPI communication?

8. A basic Wi-Fi application: Configure CC3100 Booster Pack connected to MSP430F5529 launchpad as a Wireless Local Area Network (WLAN) Station to send Email over SMTP.
   **Exercises:**
   a) Identify the code that helps in establishing connection over SMTP. Modify the code to trigger E-mail application based upon external analog input.
   b) How to configure the AP WLAN parameters and network parameters (IP addresses and DHCP parameters) using CC3100 API.

**Lab Manual:**

1) www.ti.com/lab-maunals
   • Embedded System Design using MSP430 Launchpad Development Kit - Lab Manual,