SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

AN AUTONOMOUS INSTITUTION

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

19EE503-Microprocessor and Microcontroller

QUESTION BANK

1. What is microprocessor?

A microprocessor is a multipurpose, programmable, clock-driven, register-based electronic device that reads binary information from a storage device called memory, accepts binary data as input and processes data according to those instructions, and provides result as output.

2. What is Accumulator?

The Accumulator is an 8-bit register that is part of the arithmetic/logic unit (ALU). This register is used to store 8-bit data and to perform arithmetic and logical operations. The result of an operation is stored in the accumulator. The accumulator is also identified as register A.

3. What is stack?

The stack is a group of memory locations in the R/W memory that is used for temporary storage of binary information during the execution of a program.

4. What is a subroutine program?

A subroutine is a group of instructions written separately from the main program to perform a function that occurs repeatedly in the main program. Thus subroutines avoid the repetition of same set of instructions in the main program.

5. Define addressing mode.

Addressing mode is used to specify the way in which the address of the operand is specified within the instruction.

6. Define instruction cycle.

It is defined as the time required to complete the execution of an instruction.

7 . Write a program to add a data byte located at offset 0500H in 2000H segment to another data byte available at 0600H in the same segment and store the result at 0700H in the same segment.

- MOV AX, 2000H;
- initialize DS with value MOVDS, AX;
- 2000H MOV AX, [500H];
- Get first data byte from 0500H offset ADD AX, [600H];
- Add this to the second byte from 0600H MOV [700H],AX;
- store AX in 0700H HLT;
- Stop.

8. What are the different types of addressing modes of 8086 instruction set? The different addressing modes are:

- i. Immediate
- ii. Direct
- iii. Register
- iv. Register indirect
- v. Indexed

- vi. Register relative
- Based indexed
- Relative based indexed

9. What are the different types of instructions in 8086 microprocessor?
The different types of instructions in 8086 microprocessor are:

- i. Data copy / transfer instructions
- ii. Arithmetic and logical instructions
- iii. Branch instructions iv. Loop instruction
- v. Machine control instruction
- vi. Flag manipulation instruction
- vii. Shift and rotate instruction
- viii. String instruction

10. What is assembly level programming?
A program called assembler is used to convert the mnemonics of instruction and data into their equivalent object code modules. The object code modules are further converted into executable code using linker and loader programs. This type of programming is called assembly level programming

11. What are the functional parts of 8086 CPU?
The two independent functional parts of the 8086 CPU are:
i. Bus Interface Unit (BIU):
BIU sends out addresses, fetches instruction from memory, reads data from ports and memory and writes data to ports and memory.
ii. Execution Unit (EU):
EU tells the BIU where to fetch instructions or data, decodes instructions and executes instructions.

12. What is the purpose of a decoder in EU?
The decoder in EU translates instructions fetched from memory into a series of actions, which the EU carries out.

13. Give the register classification of 8086.
The 8086 contains:
i. General purpose registers:
They are used for holding data, variables and intermediate results temporarily.
ii. Special purpose registers:
They are used as segment registers, pointers, index register or as offset storage registers for particular addressing modes.

14. Give the different segment registers.
The four segment registers are:
i. Code segment register:
It is used for addressing a memory location in the code segment of the memory, where the executable program is stored.
ii. Data segment register:
It points to the data segment of the memory, where data is resided.
iii. Extra segment register:
It also contains data.
iv. Stack segment register:
It is used for addressing stock segment of memory. It is used to store stack data.

15. What are pointers and index registers?
IP, BP and SP are the pointers and contain offsets within the code, data and stack segments

respectively. SI and DI are the index registers, which are used as general purpose registers and
also for offset storage in case of indexed, based indexed and relative based indexed addressing
modes.

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vi. Flag manipulation instruction
vii. Shift and rotate instruction
viii. String instruction

16 mark

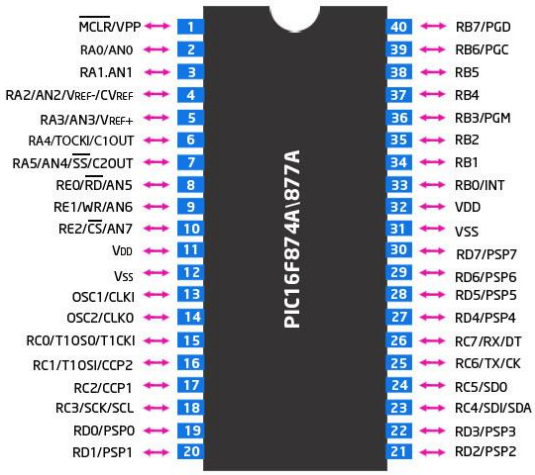
1) Explain in detail about the Architecture of 8086.
2) Explain about the various Instructions set.
3) Write an ALP to add and subtract two numbers.
4) Write an ALP to Mul and divide two numbers.
5) Describe in detail about the various register organisation in 8086.
6) Discuss about Addressing modes of 8086.

Unit II

1.what is PIC ?

Peripheral Interface Controllers (PIC) is one of the advanced microcontrollers developed by microchip technologies. These microcontrollers are widely used in modern electronics applications. A PIC controller integrates all types of advanced interfacing ports and memory modules. These controllers are more advanced than normal microcontrollers like 8051. All PIC microcontroller family uses Harvard architecture. This architecture has the program and data accessed from separate memories so the device has a program memory bus and a data memory bus.

2. Draw the pin diagram of PIC



2.What are the analog features of PIC 16f877

Analog Features

- 10-bit, 8-channel A/D Converter
- Brown-Out Reset
- Analog Comparator module
    - 2 analog comparators
    - Programmable on-chip voltage reference module
    - Programmable input multiplexing from device inputs and internal VREF
    - Comparator outputs are externally accessible

3. List the components of CPU (Central Processing Unit):

PIC microcontroller's CPU consists of

- Arithmetic logic unit (ALU)
- Memory unit (MU)
- Control unit (CU)
- Accumulator

ALU is used for arithmetic operations and for logical decisions. Memory is used for storing the instructions after processing. Control unit is used to control the internal and external peripherals which are connected to the CPU and accumulator is used for storing the results.

4. . List the memory units of PIC

The memory of a PIC 16F877 chip is divided into 3 sections

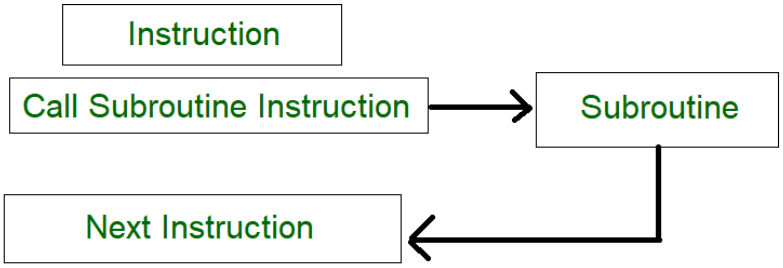
Program memory
Data memory and
Data EEPROM

5. what is a subroutine?

SUBROUTINE:

A set of instructions that are used repeatedly in a program can be referred to as Subroutine. Only one copy of this Instruction is stored in the memory. When a Subroutine is required it can be called many times during the Execution of a particular program. A *call Subroutine Instruction* calls the Subroutine. Care Should be taken while returning a Subroutine as Subroutine can be called from a different place from the memory.

The content of the PC must be Saved by the call Subroutine Instruction to make a correct return to the calling program.

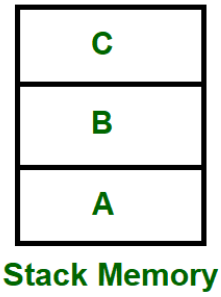


Subroutine-flow diagram

6.What is stack?

STACK:

Stack is a basic data structure that can be implemented anywhere in the memory. It can be used to store variables that may be required afterward in the program Execution. In a stack, the first data put will be the last to get out of a stack. So the last data added will be the first one to come out of the stack (last in first out).



Stack memory having data A, B & C

So from the diagram above first A is added then B & C. While removing first C is Removed then B & A.

7.What is Embedded C programming?

Embedded systems are designed to have their unique hardware and software.

Before the implementation of embedded C programming language, developers used assembly level programming language to program the embedded system.Embedded C programming plays a key role in performing specific function by the processor.

Advantages of Embedded

- Easy to understand
- High Reliability
- Portability
- Scalability
- Lesser time consumed

8. What is ALP? How its instructions are given?

Assembly languages were developed to provide mnemonics or symbols for the machine level code instructions. Assembly language programs consist of mnemonics, thus they should be translated into machine code. A program that is responsible for this conversion is known as assembler.

A program language instruction consists of the following four fields –

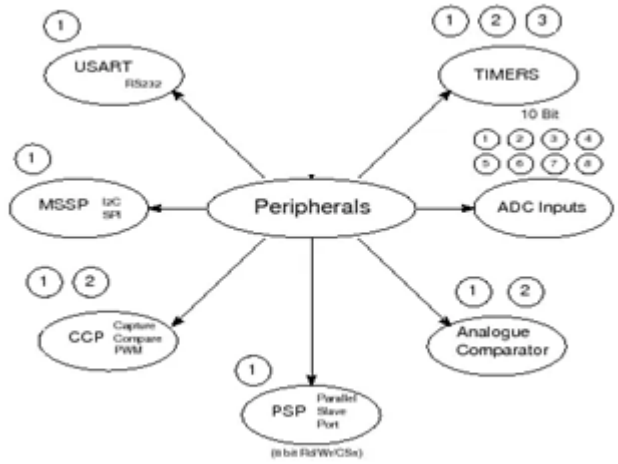
[label:] mnemonics [operands] [;comment]

A square bracket ([ ]) indicates that the field is optional.

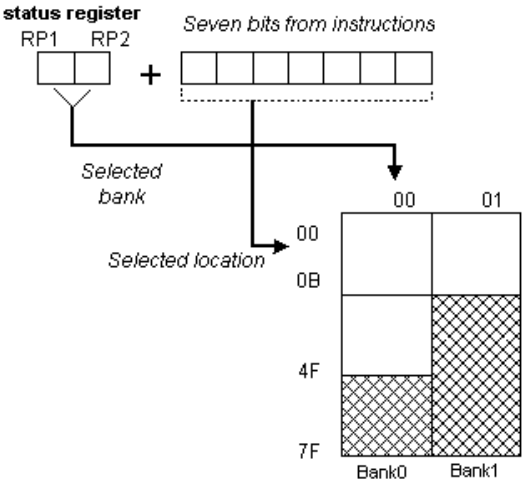
- The label field allows the program to refer to a line of code by name. The label fields cannot exceed a certain number of characters.
- The mnemonics and operands fields together perform the real work of the program and accomplish the tasks.

9. Give the necessity of a pheripheral also list the peripherals in a PIC

A peripheral is a part of a microcontroller that interfaces with the outside world. Examples of peripherals are GPIOs, I2C, SPI, UART, timers, and USB

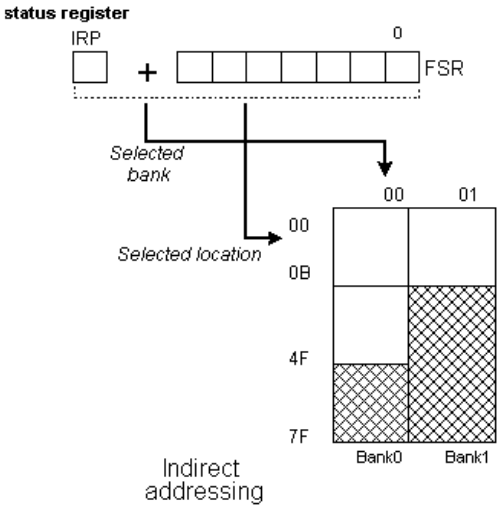


10. Draw the diagram of direct addressing



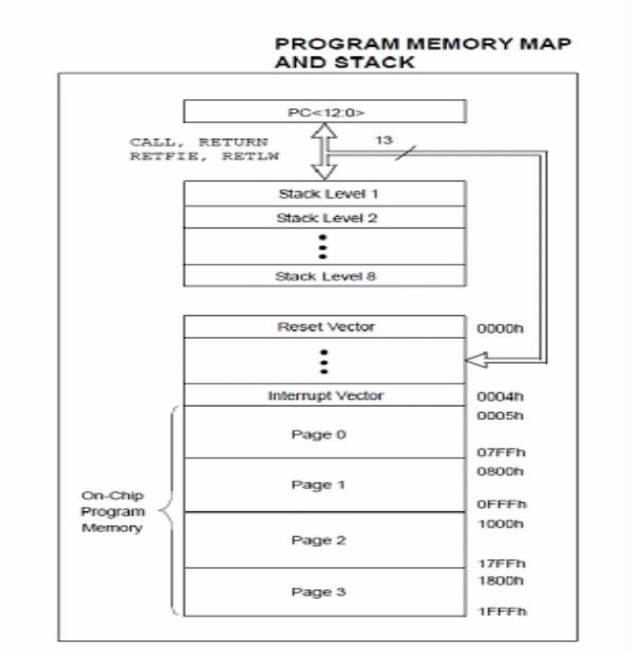
11. Brief about Indirect addressing

It does not take an address from an instruction. But it derives from IRP bit of STATUS and FSR registers. Addressed location is accessed through INDF register. And INDF register in fact holds the address indicated by the FSR. Indirect addressing is very convenient for manipulating data arrays located in GPR registers. In this case, it is necessary to initialise FSR register with a starting address of the array, and the rest of the data can be accessed by increment the FSR register.



12) What is program memory?

Program memory contains the programs that are written by the user. The program counter (PC) executes these stored commands one by one. Usually PIC16F877 devices have a 13 bit wide program counter that is capable of addressing 8K×14 bit program memory space. This memory is primarily used for storing the programs that are written (burned) to be used by the PIC. These devices also have 8K*14 bits of flash memory that can be electrically erasable /reprogrammed. Each time we write a new program to the controller, we must delete the old one at that time. The figure below shows the program memory map and stack.



14 What is data memory?

The data memory of PIC16F877 is separated into multiple banks which contain the general-purpose registers (GPR) and special function registers (SPR). According to the type of the

microcontroller, these banks may vary. The PIC16F877 chip only has four banks (BANK 0, BANK 1, BANK 2, and BANK4). Each bank holds 128 bytes of addressable memory.

15. What is SFR?
These registers are used for special purposes and they cannot be used as normal registers. Their function is set at the time of manufacturing. They perform the function assigned to them and user cannot change the function of SFR. Three important SFRs for programming are:

STATUS register: It changes the bank

PORT registers: It assigns logic values 0 or 1 to the ports

TRIS registers: It is a data direction register for input and output

16. List the various Input/Output ports

I/O PORTS:
it consists of five ports, such as Port A, Port B, Port C, Port D and Port E. with TRISA, TRISB, TRISC, TRISD, TRISE as the direction register.

16 Marks

1. With a neat diagram discuss in detail about the architecture of PIC micro controller. (16)
2. Discuss in detail about the function of various port pin of PIC micro controller (16)
3. Explain the different addressing modes of PIC micro controller. (8)
4. Discuss in detail about the memory organization of PIC micro controller. (16)
5. Discuss about the various function of PORT in PIC micro controller. (8)
6. Describe about the Special Function Register.
7.Discuss the role of MP-LAB in PIC programming.

Unit III

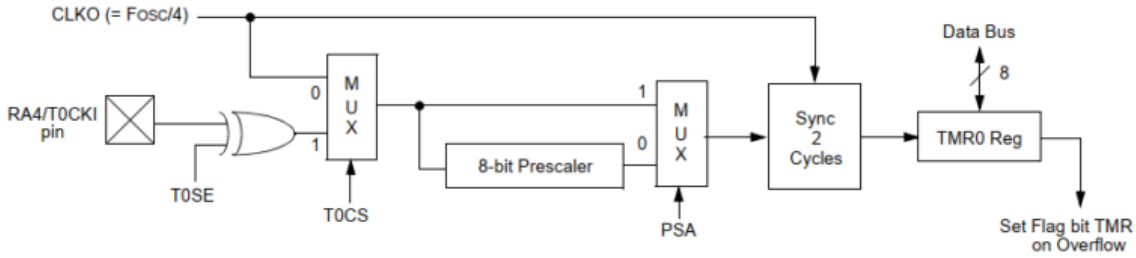
1. How is data serially communicated in a PIC
The transfer of one bit of data at time consecutively over a communication channel is called Serial Communication. There are three protocols of serial communication:

- USART,
- SPI Protocol,
- I2C Protocol

2.what are the Various timers available in a PIC 16F877
TIMERS:
Timers and counters are important as timers can tell the time and count. PIC microcontroller can have up to four timers (depending upon the family) Timer0, Timer1, Timer2 and Timer3.

Timer0 and Timer2 are of 8-bits while the Timer1 and Timer3 are of 16-bits, which can also be used as a counter. These timers work according to the selected modes.

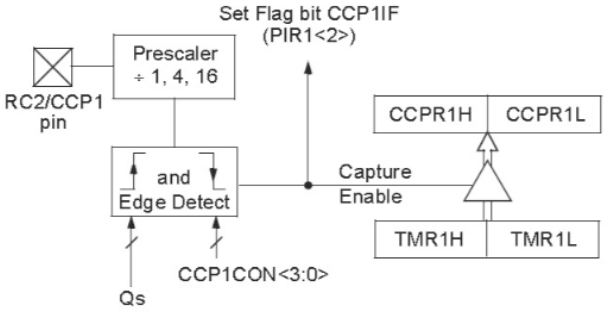
3. Draw the Timer 0 block diagram



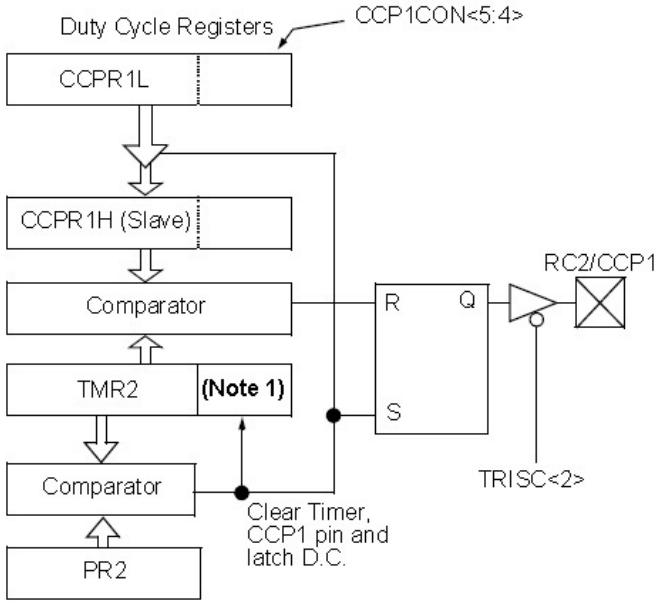
3. What is a capture module in 16F877

Capture Mode:

CCP1 Module: Capture/Compare/PWM Register 1 (CCPR1) is comprised of two 8-bit registers: CCPR1L (low byte) and CCPR1H (high byte). The CCP1CON register controls the operation of CCP1. The special event trigger is generated by a compare match and will reset Timer1.



4. Give the PWM Mode of operation diagram.



5. Define watchdog timer

The Watchdog Timer is a free running, on-chip RC oscillator which does not require any external components. This RC oscillator is separate from the RC oscillator of the OSC1/CLKI pin. That means that the WDT will run even if the clock on the OSC1/CLKI and

OSC2/CLKO pins of the device has been stopped, for example, by execution of a SLEEP instruction. During normal operation, a WDT time-out generates a device Reset (Watchdog Timer Reset). If the device is in Sleep mode, a WDT time-out causes the device to wake-up and continue with normal operation (Watchdog Timer Wake-up). The TO bit in the Status register will be cleared upon a Watchdog Timer time-out.

6. Give the purpose of Digital to analog converter in PIC.

There are no **analog outputs in PIC Microcontroller.** To get analog output we have to use external Digital-to-Analog Converter (DAC). It can convert 8 bits of digital number from the eight digital. outputs of PIC microcontroller.

7. Compare flash memory and EEPROM:

Flash memory	EEPROM
Based on NAND gates	Based on NOR gates
Memory density is more compared to EEPROM	Memory density is less compared to flash memory
Access to this memory is slower as the architecture is based on NAND	Access to this memory is faster as the architecture is based on NOR
Supports Erase, Write, Read operations	Supports Erase, Write, Read operations
Flash is erased block-wise	EEPROM is erased byte-wise
Write cycles are faster than EEPROM Read cycles are slower than EEPROM Erase cycles are faster than EEPROM	Write cycles are slower than flash Read cycles are faster than flash Erase cycles are slower than flash
Memory access in sequential. So, read is slower	Memory access in random. So, read is faster
Cheaper	Costly
Mainly used for program storage and data storage	Mainly used in applications to store configuration data.
Less endurance than EEPROM	More endurance than flash memory
Maximum erase/write cycles are less than EEPROM	Maximum erase/write cycles are more than flash
Size of this range up to GB	Size of this range from KB to MB.
USB thumb drives, hard disk and other mass storage media use flash memory	Examples of this memory usage include configuration storage in embedded boards`
Life cycle is more than EEPROM	Life cycle is lesser than flash
Parallel (D0-D7 along with control lines and address lines) interface for the microcontroller/processor	I2C, SPI interface for the microcontroller/processor
Example: S34ML16G202TFI200 from Cypress	Example: AT24C512C from ATMEL

8. What is USART?

USART: It stands for Universal synchronous and Asynchronous Receiver and Transmitter which provides a serial communication in two devices. In this protocol data is transmitted and received bit by bit through a single wire according to the clock pulses. To send and receive data serially the PIC microcontroller has two pins TXD and RXD.

9. What is SPI protocol

- **SPI Protocol:**

sSPI stands for Serial Peripheral Interface. It is used to send data between PIC microcontrollers and other peripherals like sensors, shift registers and SD cards. Three wire SPI communications is supported in PIC microcontroller between two devices on a common clock source. SPI protocol has greater data handling capability than that of the USART.

10.Give the registers associated with PIC16F877A ADC

Register	Description

ADCON0	Used to Turn ON the ADC, Select the Sampling Freq and also Start the conversion.
ADCON1	Used to configure the gpio pins for ADC
ADRESH	Holds the higher byte of ADC result
ADRESL	Holds the lower byte of ADC result

11. Brief the various registers associated with Timer 2

Registers	Description
T2CON	This registers is used to configure the TIMER2 Prescalar, Clock Source etc
TMR2	This register will hold the Count value. When this register equals PR2 register then an interrupt will be generated and TMR2 is reset
PIR1	This register contains the Timer2 overflow flag(TMR2IF).
PIE1	This register contains the Timer2 Interrupt Enable flag(TMR2IE).

16 marks
1. Explain in detail about the compare and capture mode of the PIC micro controller with a neat diagram. (8)
2. Discuss in detail about the following
a. DAC
b. Timers
c. Interrupt (16)
3. Write a detailed note on the FLASH & EEPROM memories. (8)
4. Explain the USART in PIC micro controller. (8)
5. Briefly explain the sensor interfacing using PIC micro controller.
6. Explain about the Led interfacing, LCD Interfacing with PIC16F877.
7. Discuss about the stepper mode interfacing.
8. Explain about the Keypad Interfacing with PIC16F877.

Unit IV

1.What are Arm processor features?
Because of their reduced instruction set, Arm processors require fewer transistors, resulting in a smaller die size for the integrated circuitry. Their smaller size, reduced complexity and lower power consumption make them suitable for increasingly miniaturized devices.

2.What are the features of ARM processor?
Arm processor features include the following:

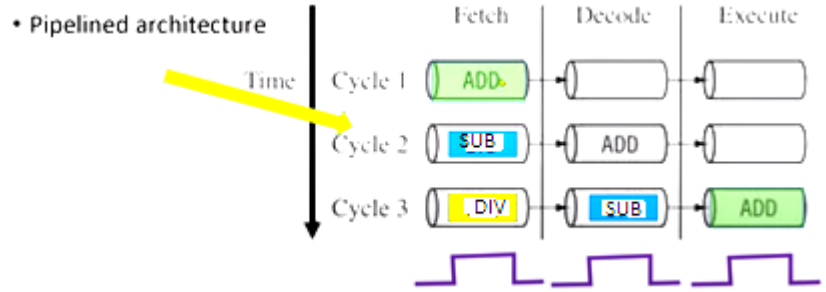
- load/store architecture
- integrated security
- orthogonal instruction set
- single-cycle execution
- energy efficiency
- 64- and 32-bit execution states

3) What is Advanced RISC Machine (ARM) Processor?
It is defined as family of CPUs that have wide usage in electronic devices such as smartphones, wearable, tablets and multimedia players.

4) List the advantages of ARM processor.
Advantages of ARM Processor:

- Affordable to create
- Low Power Consumption
- Work Faster
- Multiprocessing feature
- Better Battery Life
- Load store architecture

5) What is pipeline?



6) What is thumb instruction?

- It has separate barrel shifter and ALU Instructions
- No Direct access over Program Status
- It has only 30 Instructions
- It has high number registers

7) Give the detail about load Instruction

✓ Load instructions

- LDR – Load Register from given memory location {32 bits data}

  LDR R0, [R1]
- It will load R0 with the data pointed at memory location by R1, it will load 32bits data.
- LDRB – Load Register from given memory location {8 bits data}

  LDRB R0, [R1]
- It will load R0 with the data pointed at memory location by R1, it will load 8bits data.
- LDRH – Load Register from given memory location {16 bits data}

  LDRH R0, [R1]
- It will load R0 with the data pointed at memory location by R1, it will load 16bits data.
- LDRSB – Load Register from given memory location {8 bits signed data}

  LDRSB R0, [R1]
- It will load R0 with the data pointed at memory location by R1, it will load 8bits signed data.
- LDRSH – Load Register from given memory location {16 bits signed data}

  LDRSH R0, [R1]
- It will load R0 with the data pointed at memory location by R1, it will load 16bits signed data.

8) what is SWI instructions?

SWI – Software Interrupt.

- A software interrupt instruction (SWI) causes a software interrupt exception, which provides a mechanism for applications to call operating system routines
  - Syntax: SWI {<cond>} SWI_number
- When the processor executes an SWI instruction, it sets the program counter pc to the offset 0x8 in the vector table.
- The instruction also forces the processor mode to SVC, which allows an operating system routine to be called in a privileged mod

9) Give the detail about Store Instruction

✓ Store instructions

- STR – Store Register on given memory location {32 bits data}

  STR R0, [R1]
- It will store R0 at memory location pointed R1, it will Store 32bits data.
- Similarly,
- STRB – Store Register on given memory location {8 bits data}
- STRH – Store Register on given memory location {16 bits data}
- STRSB – Store Register on given memory location {8 bits Signed data}
- STRSH – Store Register on given memory location {16 bits Signed data}

10. List the Branch Instruction.

Branch
Branch with link
Branch Exchange
Branch Exchange with link

16 mark

Explain about ARM architecture in detail.

2) discuss about exceptions and interrupts interrupt vector table

3) Discuss about Data processing instruction in detail.

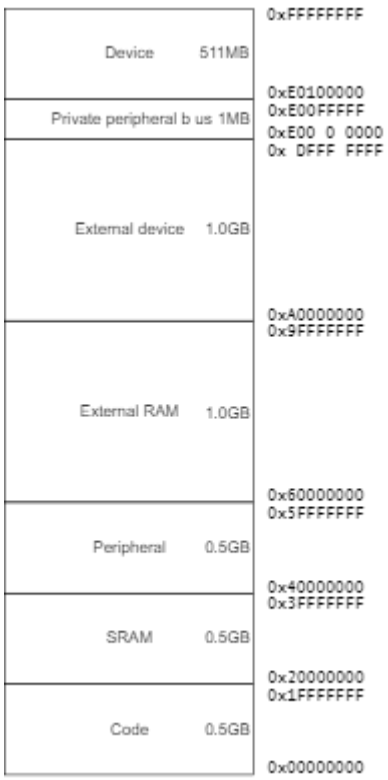
4) Explain about Branch instructions, load store instructions.
5) Explain about Software interrupt instructions, Program status register instructions
6) Discuss about the following
i) loading constants,
ii) Conditional execution

Unit V

1) Give the overview of ARM cortex.
   Greater performance efficiency: allowing more work to be done without increasing the frequency or power requirements
   •□ Low power consumption: enabling longer battery life, especially critical in portable products including wireless networking applications
   Enhanced determinism: guaranteeing that critical tasks and interrupts are serviced as quickly as possible and in a known number of cycles
   •□ Improved code density: ensuring that code fits in even the smallest memory footprints •□ Ease of use: providing easier programmability and debugging for the growing number of 8-bit and 16-bit users migrating to 32 bits
   •□ Lower cost solutions: reducing 32-bit-based system costs close to those of legacy 8-bit and 16-bit devices and enabling low-end, 32-bit microcontrollers to be priced at less than US$1 for the first time
   •□ Wide choice of development tools: from low-cost or free compilers to full-featured development suites from many development tool vendors

2) Draw the programmers model of Arm cortex M0
   PROGRAMMERS MODEL IS REGISTER SET- SAME IN UNIT 4

3) Draw memory system overview



4) List the registers of system control block
   SYSTick Register

   CPUID Register

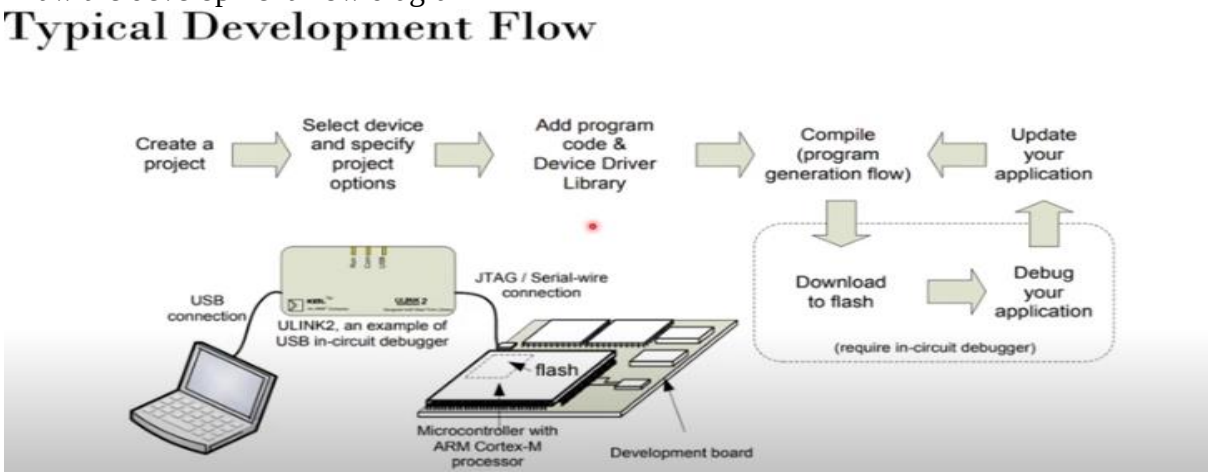
   ICSR-Interrupt control state

   AIRCR

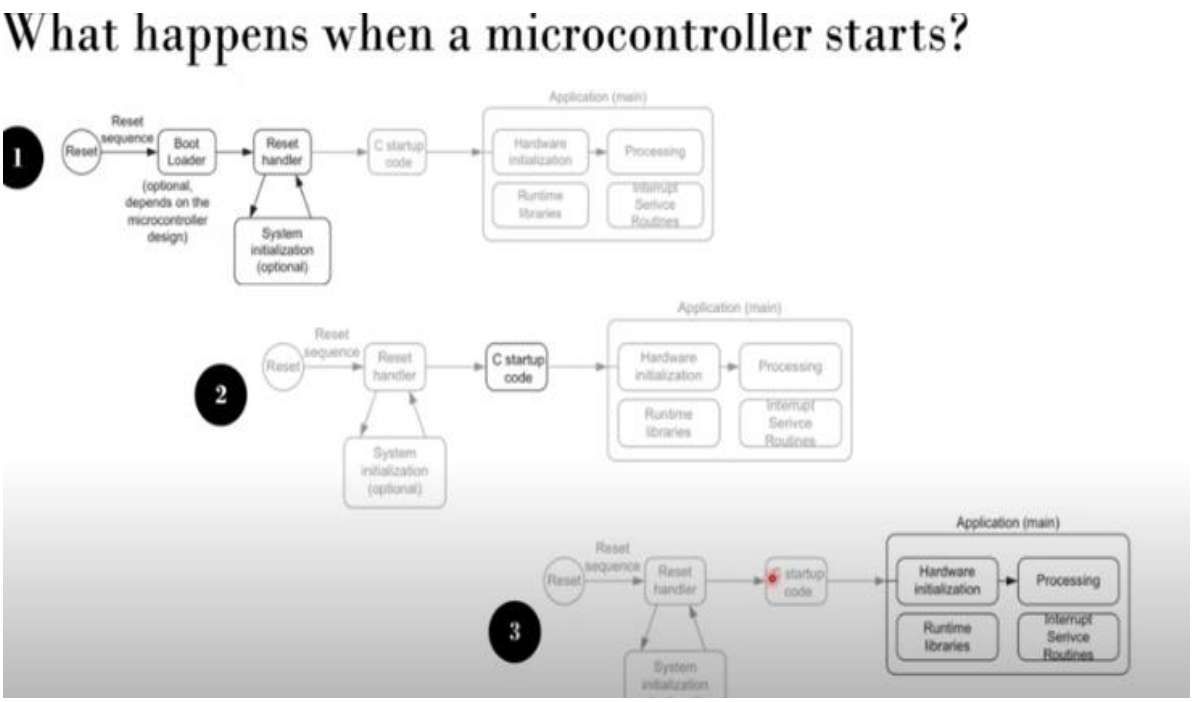
   CCR- Configuration and control register

   SH-system handler

5) Draw the development flow diagram



6) What is the microcontroller start sequence?



7) List the advantages of Arm cortex M0
8) **List the Application of Cortex**

   Automotive body systems

   Industrial control systems

   Wireless networking and sensors

16 mark

1) With a neat diagram, explain the architecture of ARM Cortex M0.
2) Explain in detail about the programmer's model in ARM cortex.
3) Describe about the memory system overview.
4) With detailed description, give the various components that are available in the system control block.
5) Explain about the microcontroller start sequence.
6) List out the various Inputs and outputs of Arm cortex M0. Also explain in detail about the same.
7) Discuss in detail about the development flow of Arm cortex M0.