

Subject Name Solutions

1333202 – Summer 2025

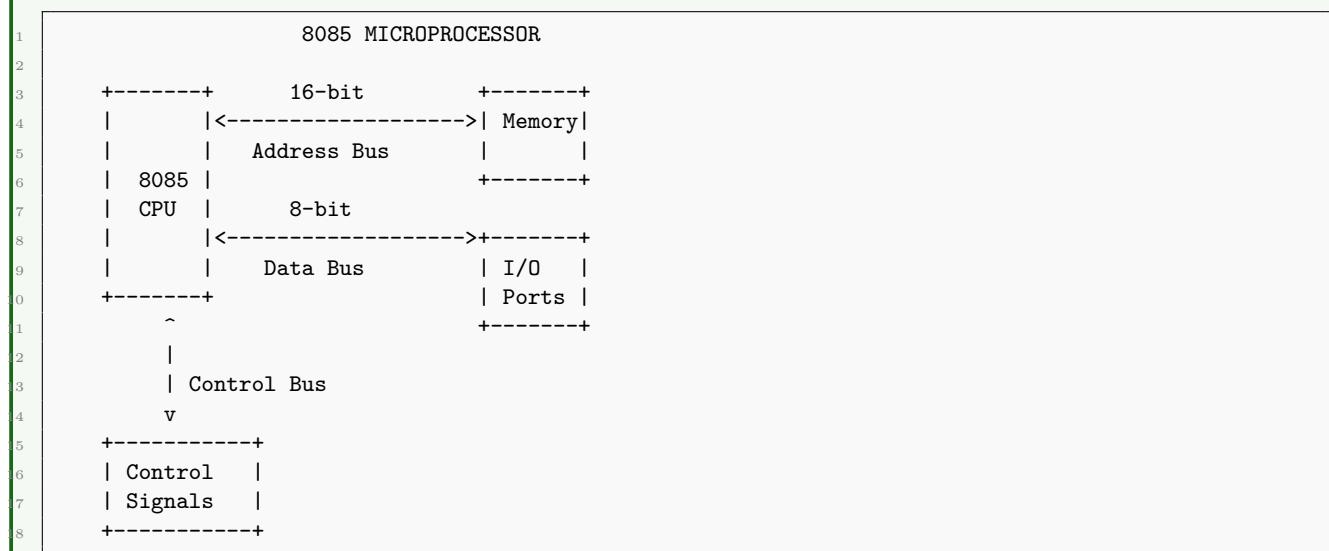
Semester 1 Study Material

Detailed Solutions and Explanations

Question 1(A) [3 marks]

Draw The Bus Organization Of 8085.

Solution



Bus Types:

- **Address Bus:** 16-bit unidirectional bus for memory addressing
- **Data Bus:** 8-bit bidirectional bus for data transfer
- **Control Bus:** Control signals like RD, WR, ALE, IO/M

Mnemonic

“ADC - Address, Data, Control”

Question 1(B) [4 marks]

Compare Microp processor With Microcontroller.

Solution

Feature	Microprocessor	Microcontroller
Architecture	External components needed	All components on single chip
Memory	External RAM/ROM required	Internal RAM/ROM available
Cost	Higher system cost	Lower system cost
Power	Higher power consumption	Lower power consumption
Size	Larger system size	Compact system
Applications	General purpose computing	Embedded control applications

Key Points:

- **Microprocessor:** CPU only, requires external support chips
- **Microcontroller:** Complete computer system on chip

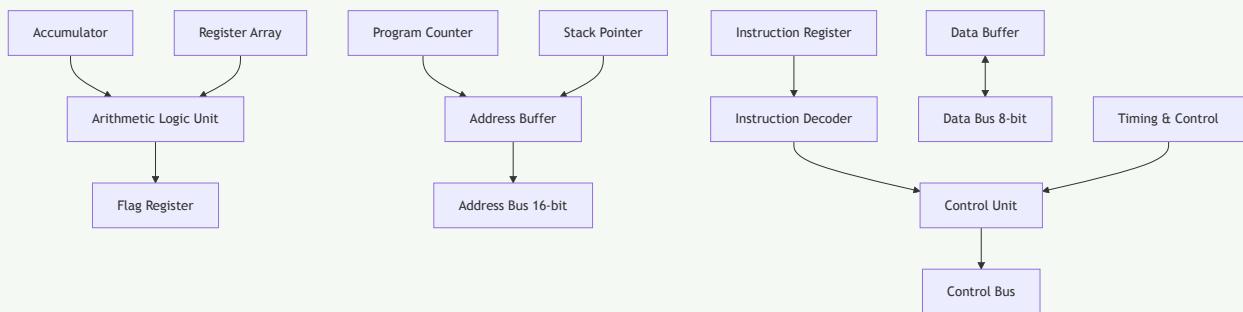
Mnemonic

“MICRO - Memory Internal, Compact, Reduced cost, Optimized”

Question 1(C) [7 marks]

Draw And Explain Each Block Of 8085 Microprocessor.

Solution



Block Functions:

- ALU:** Performs arithmetic and logical operations
- Accumulator:** Primary working register for data processing
- Register Array:** B, C, D, E, H, L general purpose registers
- Program Counter:** Holds address of next instruction
- Stack Pointer:** Points to top of stack in memory
- Control Unit:** Controls overall operation of processor

Mnemonic

“APRIL - ALU, Program counter, Registers, Instruction decoder, Logic control”

Question 1(C) OR [7 marks]

Draw Pin Diagram Of 8085 Microprocessor And Explain Any 4(Four) Pins.

Solution

8085 PIN DIAGRAM			
X1	1	+	40 Vcc
X2	2		39 HOLD
RESET	3		38 HLDA
SOD	4		37 CLK(OUT)
SID	5	8085	36 RESET IN
TRAP	6		35 READY
RST7.5	7		34 IO/M
RST6.5	8		33 S1
RST5.5	9		32 RD
INTR	10		31 WR
INTA	11		30 ALE
AD0-7	12-19		23-29 A8-A15
Vss	20	+	21 A15-A8

Pin Explanations:

- ALE (Pin 30):** Address Latch Enable - separates address and data on multiplexed bus
- RD (Pin 32):** Read control signal - active low, indicates read operation
- WR (Pin 31):** Write control signal - active low, indicates write operation
- RESET (Pin 36):** Reset input - initializes processor when low

Mnemonic

“ARWA - ALE, Read, Write, rAset”

Question 2(A) [3 marks]

Define : (1) Opcode (2) Operand

Solution

Definitions:

- **Opcode:** Operation Code - specifies the operation to be performed (ADD, MOV, JMP)
- **Operand:** Data or address on which operation is performed

Example:

```
1 MOV A, B
2 |   |   |
3 |   |   +- Operand 2 (Source)
4 |   +- Operand 1 (Destination)
5 +- Opcode
```

Mnemonic

“OO - Operation + Operand”

Question 2(B) [4 marks]

Give Differences Between RISC And CISC.

Solution

Feature	RISC	CISC
Instructions	Simple, fixed format	Complex, variable format
Execution	Single cycle execution	Multiple cycle execution
Addressing	Few addressing modes	Many addressing modes
Memory	Load/Store architecture	Memory-to-memory operations
Compiler	Complex compiler design	Simple compiler design

Key Points:

- **RISC:** Reduced Instruction Set Computer - simpler, faster
- **CISC:** Complex Instruction Set Computer - feature rich

Mnemonic

“RISC is SLIM - Simple, Load-store, Instruction reduced, Memory efficient”

Question 2(C) [7 marks]

Give Differences Between Von-Neumann & Harvard Architecture.

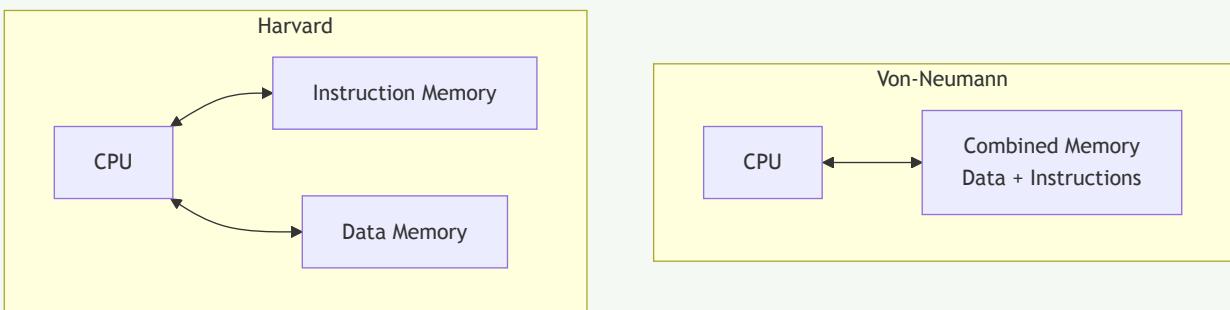
Solution

Feature	Von-Neumann	Harvard
Memory	Single memory for data and instructions	Separate memory for data and instructions
Bus Structure	Single bus system	Dual bus system
Access	Sequential access to data and instructions	Simultaneous access possible
Cost	Lower cost	Higher cost

Speed Examples

Slower due to bus conflicts
8085, General computers

Faster parallel access
8051, DSP processors



Mnemonic

"VH - Von has one bus, Harvard has two"

Question 2(A) OR [3 marks]

Define : (1) T-State (2) Instruction Cycle (3) Machine Cycle

Solution

Definitions:

- **T-State:** Time state - basic timing unit, one clock period
- **Instruction Cycle:** Complete execution of one instruction
- **Machine Cycle:** Group of T-states required for one memory operation

Relationship:

1 Instruction Cycle = Multiple Machine Cycles
2 Machine Cycle = Multiple T-States (3-6 T-states)

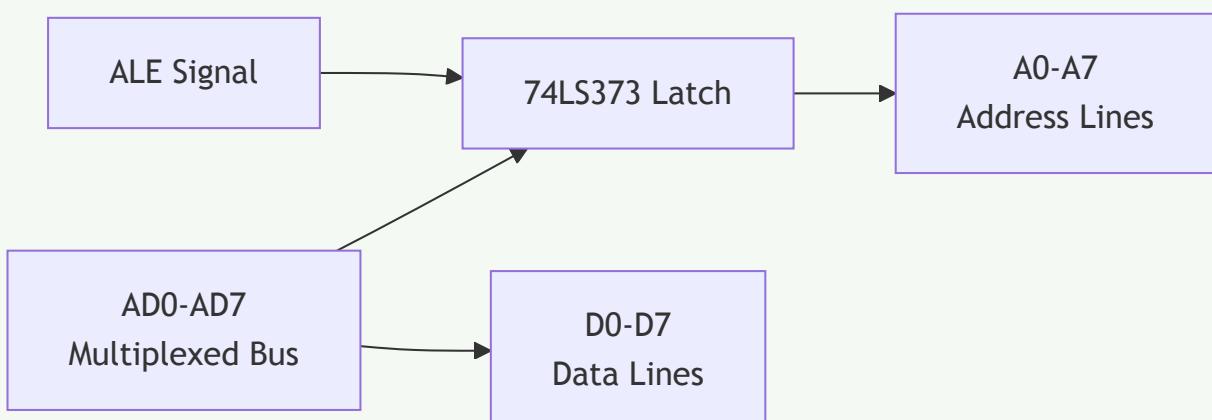
Mnemonic

"TIM - T-state, Instruction cycle, Machine cycle"

Question 2(B) OR [4 marks]

Explain De-Multiplexing Of Address And Data Bus Of 8085.

Solution



Process:

- **Step 1:** During T1, AD0-AD7 contains lower 8-bit address
- **Step 2:** ALE goes high, latches address in external latch
- **Step 3:** AD0-AD7 becomes data bus for remaining T-states

Components Required:

- **74LS373:** Octal latch IC for address latching
- **ALE:** Address Latch Enable signal for timing

Mnemonic

“LAD - Latch Address with Data separation”

Question 2(C) OR [7 marks]

Draw And Explain Flag Register Of 8085.

Solution

1	D7	D6	D5	D4	D3	D2	D1	D0
2	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+
3	S Z X AC X P X CY							
4	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+	+-----+

Flag Descriptions:

- **CY (D0):** Carry flag - Set when carry occurs
- **P (D2):** Parity flag - Set for even parity
- **AC (D4):** Auxiliary carry - Set for BCD operations
- **Z (D6):** Zero flag - Set when result is zero
- **S (D7):** Sign flag - Set when result is negative

Flag Operations:

- **Conditional Jumps:** Based on flag status (JZ, JC, JP)
- **Arithmetic Results:** Automatically updated after ALU operations

Mnemonic

“SZAPC - Sign, Zero, Auxiliary, Parity, Carry”

Question 3(A) [3 marks]

What Is SFR ? List Out Any Three SFR.

Solution

SFR Definition: Special Function Register - Dedicated registers with specific functions in microcontroller
Three SFRs:

- **ACC (E0H):** Accumulator register
- **PSW (D0H):** Program Status Word
- **SP (81H):** Stack Pointer register

Characteristics:

- **Address Range:** 80H to FFH in internal RAM
- **Bit Addressable:** Some SFRs allow individual bit access
- **Function Specific:** Each has dedicated hardware function

Mnemonic

“APS - ACC, PSW, Stack Pointer”

Question 3(B) [4 marks]

Explain Program Counter (PC) And Data Pointer (DPTR) Register.

Solution

Program Counter (PC):

- **Size:** 16-bit register
- **Function:** Holds address of next instruction to be executed
- **Auto-increment:** Automatically increments after instruction fetch
- **Range:** 0000H to FFFFH

Data Pointer (DPTTR):

- **Size:** 16-bit register (DPH + DPL)
- **Function:** Points to external data memory locations
- **Usage:** Used with MOVX instructions for external memory access
- **Components:** DPH (83H) and DPL (82H)

```
1 PC:   +-----+-----+
2      |     PCH  |     PCL  | 16-bit
3      +-----+-----+
4
5 DPTTR: +-----+-----+
6      |     DPH  |     DPL  | 16-bit
7      +-----+-----+
8      |  83H   |  82H   |
```

Mnemonic

“PD - PC Points to Program, DPTTR Points to Data”

Question 3(C) [7 marks]

Draw And Explain Architecture Of 8051.

Solution



Architecture Components:

- CPU: 8-bit ALU with accumulator and B register
- Memory: 4KB internal ROM, 128B internal RAM
- I/O Ports: Four 8-bit bidirectional ports (P0-P3)
- Timers: Two 16-bit timers/counters (T0, T1)
- Serial Port: Full duplex UART for communication
- Interrupts: 5 interrupt sources with priority levels

Special Features:

- Boolean Processor: Bit manipulation capabilities
- Addressing Modes: 8 different addressing modes
- Power Management: Idle and power-down modes

Mnemonic

“MIPTIS - Memory, I/O, Processor, Timers, Interrupts, Serial”

Question 3(A) OR [3 marks]

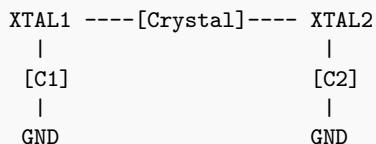
Explain Following Pins Of 8051: (1) ALE (2) PSEN (3) XTAL1 & XTAL2

Solution

Pin Functions:

- **ALE (Pin 30):** Address Latch Enable
 - Output pulse for latching lower address byte
 - Active high signal at 1/6 of oscillator frequency
- **PSEN (Pin 29):** Program Store Enable
 - Active low output for external program memory read
 - Connected to OE pin of external EPROM
- **XTAL1 & XTAL2 (Pins 19, 18):** Crystal connections
 - Connect external crystal for clock generation
 - Typical frequency: 11.0592 MHz or 12 MHz

Crystal Oscillator Connection:



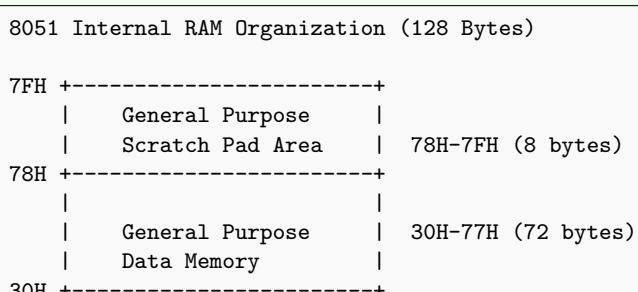
Mnemonic

“APX - ALE latches Address, PSEN enables Program, XTAL generates clock”

Question 3(B) OR [4 marks]

Describe Internal RAM Organization Of 8051 Microcontroller.

Solution



1	Bank 3 (R0-R7)	18H-1FH
2	20H +-----+	
3	Bank 2 (R0-R7)	10H-17H
4	18H +-----+	
5	Bank 1 (R0-R7)	08H-0FH
6	10H +-----+	
7	Bank 0 (R0-R7)	00H-07H
8	08H +-----+	
9	Default Register Bank	
10	00H +-----+	

RAM Sections:

- **Register Banks:** 4 banks \times 8 registers each (00H – 1FH)
- **Bit Addressable:** 16 bytes with individual bit access (20H-2FH)
- **General Purpose:** 80 bytes for user data (30H-7FH)
- **Stack Area:** Usually starts from 08H upward

Addressing:

- **Direct:** Using actual address (MOV 30H, A)
- **Indirect:** Using register pointer (MOV @R0, A)

Mnemonic

“RBGS - Register banks, Bit addressable, General purpose, Stack”

Question 3(C) OR [7 marks]

Draw Pin Diagram Of 8051 And Explain Any 04(Four) Pins.

Solution

8051 PIN DIAGRAM			
P1.0	1	+-----+ 40	Vcc
P1.1	2	39	P0.0/AD0
P1.2	3	38	P0.1/AD1
P1.3	4	37	P0.2/AD2
P1.4	5	36	P0.3/AD3
P1.5	6	35	P0.4/AD4
P1.6	7	34	P0.5/AD5
P1.7	8	33	P0.6/AD6
RESET	9	32	P0.7/AD7
P3.0/RXD	10	31	EA/VPP
P3.1/TXD	11	30	ALE/PROG
P3.2/INT0	12	29	PSEN
P3.3/INT1	13	28	P2.7/A15
P3.4/T0	14	27	P2.6/A14
P3.5/T1	15	26	P2.5/A13
P3.6/WR	16	25	P2.4/A12
P3.7/RD	17	24	P2.3/A11
XTAL2	18	23	P2.2/A10
XTAL1	19	22	P2.1/A9
VSS	20	+-----+ 21	P2.0/A8

Pin Explanations:

- **RESET (Pin 9):** Reset input - Active high, initializes microcontroller
- **EA/VPP (Pin 31):** External Access - Controls program memory selection
- **P0 (Pins 32-39):** Port 0 - Multiplexed address/data bus for external memory
- **P2 (Pins 21-28):** Port 2 - High-order address bus for external memory

Mnemonic

“REPP - REset, External Access, Port 0, Port 2”

Question 4(A) [3 marks]

Write A Program To Multiply Data Stored In R0 Register With Data Stored In R1 Register. Store The Result In R2 Register (LSB) And R3 Register (MSB).

Solution

```
1 ORG 0000H
2 MOV R0, #05H      ; Load first number
3 MOV R1, #03H      ; Load second number
4 MOV A, R0          ; Move R0 to accumulator
5 MOV B, R1          ; Move R1 to B register
6 MUL AB            ; Multiply A and B
7 MOV R2, A          ; Store LSB in R2
8 MOV R3, B          ; Store MSB in R3
9 END
```

Program Flow:

- Load operands into R0 and R1
- Transfer to A and B registers for multiplication
- Execute MUL AB instruction
- Store 16-bit result (A=LSB, B=MSB)

Result Storage:

- **R2**: Contains lower 8 bits of product
- **R3**: Contains upper 8 bits of product

Mnemonic

“LTSE - Load, Transfer, multiply, Store result”

Question 4(B) [4 marks]

List Out Data Transfer Instructions And Explain Any Two Data Transfer Instructions With Suitable Examples.

Solution

Data Transfer Instructions:

Instruction	Function
MOV	Move data between registers/memory
MOVX	Move data to/from external memory
MOVC	Move code byte to accumulator
PUSH	Push data onto stack
POP	Pop data from stack
XCH	Exchange accumulator with register
XCHD	Exchange lower nibble

Detailed Examples:

1. MOV Instruction:

```
1 MOV A, #50H      ; Load immediate data 50H into accumulator
2 MOV R0, A          ; Copy accumulator content to R0
3 MOV 30H, A          ; Store accumulator content at address 30H
```

2. PUSH/POP Instructions:

```
1 PUSH ACC          ; Push accumulator onto stack
2 PUSH OOH          ; Push R0 content onto stack
3 POP 01H           ; Pop stack content to R1
4 POP ACC           ; Pop stack content to accumulator
```

Mnemonic

“Move Makes Programs Possible - MOV, MOVX, PUSH, POP”

Question 4(C) [7 marks]

Define And Explain Addressing Modes Of 8051.

Solution

8051 Addressing Modes:

Mode	Description	Example	Usage
Immediate	Data is part of instruction	MOV A, #50H	Constant values
Register	Uses register directly	MOV A, R0	Fast access
Direct	Uses direct address	MOV A, 30H	RAM locations
Indirect	Uses register as pointer	MOV A, @R0	Dynamic addressing
Indexed	Base + offset addressing	MOVC A, @A+DPTR	Table lookup
Relative	PC + offset	SJMP LOOP	Branch instructions
Absolute	Direct jump address	LJMP 1000H	Long jumps
Bit	Individual bit access	SETB P1.0	Control operations

Detailed Examples:

```
1 ; Immediate Addressing
2 MOV A, #25H      ; Load 25H into A
3
4 ; Register Addressing
5 MOV A, R1       ; Copy R1 to A
6
7 ; Direct Addressing
8 MOV A, 40H      ; Load from address 40H
9
0 ; Indirect Addressing
1 MOV R0, #40H    ; R0 points to 40H
2 MOV A, @R0      ; Load from address pointed by R0
3
4 ; Indexed Addressing
5 MOV DPTR, #TABLE ; Point to table
6 MOV A, #02H      ; Index value
7 MOVC A, @A+DPTR ; Load from TABLE+2
```

Mnemonic

“IRIDRAB - Immediate, Register, Indirect, Direct, Relative, Absolute, Bit”

Question 4(A) OR [3 marks]

Write A Program To Find 2's Complement of Data Stored in R0 Register.

Solution

```
1 ORG 0000H
2 MOV R0, #85H      ; Load test data
3 MOV A, R0          ; Copy data to accumulator
4 CPL A             ; Complement all bits (1's complement)
5 INC A             ; Add 1 to get 2's complement
6 MOV R1, A          ; Store result in R1
7 END
```

Algorithm:

- Step 1: Load data from R0 to accumulator

- **Step 2:** Complement all bits using CPL A
- **Step 3:** Add 1 using INC A for 2's complement
- **Step 4:** Store result back

Verification:

```

1 Original: 85H = 10000101B
2 1's Comp: 7AH = 01111010B
3 2's Comp: 7BH = 01111011B

```

Mnemonic

“CCI - Complement, aCd 1, Include result”

Question 4(B) OR [4 marks]

List Logical Instructions And Explain Any Two Logical Instructions With Suitable Examples.

Solution

Logical Instructions:

Instruction	Function
ANL	Logical AND operation
ORL	Logical OR operation
XRL	Logical XOR operation
CPL	Complement operation
RL/RLC	Rotate left
RR/RRC	Rotate right
SWAP	Swap nibbles

Detailed Examples:

1. ANL (AND Logic):

```

1 MOV A, #0FOH      ; A = 11110000B
2 ANL A, #OAAH      ; AND with 10101010B
3 ; Result:
4
5 A = 1010000B = AOH

```

Usage: Masking specific bits, clearing unwanted bits

2. ORL (OR Logic):

```

1 MOV A, #0FOH      ; A = 11110000B
2 ORL A, #0OFH      ; OR with 00001111B
3 ; Result:
4
5 A = 11111111B = FFH

```

Usage: Setting specific bits, combining bit patterns

Mnemonic

“AXOR - AND masks, XOR toggles, OR sets, Rotate shifts”

Question 4(C) OR [7 marks]

Explain Following Instructions: (1)ADDC (2) INC (3) DEC (4) JZ (5) SUBB (6) NOP (7) RET

Solution

Instruction Explanations:

1. ADDC (Add with Carry):

```
1 MOV A, #80H  
2 ADDC A, #90H ; A = A + 90H + Carry flag
```

Function: Adds source, destination, and carry flag

2. INC (Increment):

```
1 INC A ; A = A + 1  
2 INC R0 ; R0 = R0 + 1  
3 INC 30H ; (30H) = (30H) + 1
```

Function: Increases operand by 1

3. DEC (Decrement):

```
1 DEC A ; A = A - 1  
2 DEC R1 ; R1 = R1 - 1  
3 DEC 40H ; (40H) = (40H) - 1
```

Function: Decreases operand by 1

4. JZ (Jump on Zero):

```
1 DEC A  
2 JZ ZERO_LABEL ; Jump if A = 0
```

Function: Conditional jump when zero flag is set

5. SUBB (Subtract with Borrow):

```
1 MOV A, #50H  
2 SUBB A, #30H ; A = A - 30H - Carry flag
```

Function: Subtracts source and carry from accumulator

6. NOP (No Operation):

```
1 NOP ; Do nothing, consume 1 cycle
```

Function: Provides timing delay, placeholder

7. RET (Return):

```
1 CALL SUBROUTINE  
2 ...  
3 SUBROUTINE:  
4     MOV A, #10H  
5     RET ; Return to caller
```

Function: Returns from subroutine to calling address

Mnemonic

“AIDS NR - Add, Increment, Decrement, Subtract, No-op, Return”

Question 5(A) [3 marks]

Explain DJNZ And CJNE Instructions With Suitable Examples.

Solution

DJNZ (Decrement and Jump if Not Zero):

```
1 MOV R0, #05H ; Initialize counter  
2 LOOP:  
3     MOV A, #00H ; Some operation  
4     DJNZ R0, LOOP ; Decrement R0, jump if not zero
```

Function: Combines decrement and conditional jump operations

CJNE (Compare and Jump if Not Equal):

```

1 MOV A, #30H
2 CJNE A, #30H, NOT_EQUAL ; Compare A with 30H
3 MOV R0, #01H             ; Equal case
4 SJMP CONTINUE
5 NOT_EQUAL:
6     MOV R0, #00H          ; Not equal case
7 CONTINUE:

```

Function: Compares two operands and jumps if not equal

Applications:

- **DJNZ:** Loop control, counting operations
- **CJNE:** Decision making, condition checking

Mnemonic

“DC - Decrement count, Compare jump”

Question 5(B) [4 marks]

Write An Assembly Language Program To Generate The Time Delay Of 30ms Using Timer 0. Assume Crystal Frequency Is 12 MHz

Solution

```

1 ORG 0000H
2 MAIN:
3     CALL DELAY_30MS      ; Call 30ms delay
4     SJMP MAIN           ; Repeat
5
6 DELAY_30MS:
7     MOV TMOD, #01H       ; Timer 0, Mode 1 (16-bit)
8     MOV TH0, #8AH         ; Load high byte for 30ms
9     MOV TL0, #23H         ; Load low byte
0     SETB TR0             ; Start Timer 0
1
2 WAIT:
3     JNB TFO, WAIT        ; Wait for timer overflow
4     CLR TR0              ; Stop timer
5     CLR TFO              ; Clear timer flag
6     RET
7 END

```

Calculation for 30ms delay:

```

1 Crystal Frequency = 12 MHz
2 Machine Cycle = 12/12 MHz = 1 µs
3 For 30ms = 30,000 µs = 30,000 machine cycles
4
5 Timer Count = 65536 - 30000 = 35536 = 8A23H
6 TH0 = 8AH, TL0 = 23H

```

Timer Configuration:

- **TMOD:** Timer mode register configuration
- **TH0/TLO:** Timer 0 high/low byte registers
- **TR0:** Timer 0 run control bit
- **TF0:** Timer 0 overflow flag

Mnemonic

“CLSW - Calculate, Load, Start, Wait”

Question 5(C) [7 marks]

Draw The Interfacing Diagram Of LCD With 8051. Explain Pins Of LCD Which Are Necessary For Interfacing.

Solution

```
1 8051 to LCD Interfacing (4-bit mode)
2
3 8051           16x2 LCD
4 -----
5 P2.7 -----> D7  (Pin 14)
6 P2.6 -----> D6  (Pin 13)
7 P2.5 -----> D5  (Pin 12)
8 P2.4 -----> D4  (Pin 11)
9
10 P1.2 -----> EN  (Pin 6)
11 P1.1 -----> RW  (Pin 5)
12 P1.0 -----> RS  (Pin 4)
13
14 +5V  -----> VCC (Pin 2)
15 GND  -----> VSS (Pin 1)
16 GND  -----> VEE (Pin 3) [Contrast]
```

LCD Pin Functions:

- **RS (Pin 4)**: Register Select - 0=Command, 1=Data
- **RW (Pin 5)**: Read/Write - 0=Write, 1=Read
- **EN (Pin 6)**: Enable - High to low pulse for data transfer
- **D4-D7 (Pins 11-14)**: 4-bit data lines for commands/data

Interface Requirements:

- **Power Supply**: VCC=+5V, VSS=GND, VEE=Contrast control
- **Control Lines**: 3 pins (RS, RW, EN) for LCD control
- **Data Lines**: 4 pins (D4-D7) for 4-bit mode operation

Basic LCD Commands:

- **0x38**: Function set (8-bit, 2 lines)
- **0xE0**: Display ON, cursor ON
- **0x01**: Clear display
- **0x80**: Set cursor to first line

Mnemonic

“REED - RS selects, RW reads, EN enables, Data transfers”

Question 5(A) OR [3 marks]

Write A Program To Perform OR Operation On Data Stored In 65h Memory Location With Data Stored In 75h Memory Location. Store The Result In R6 Register.

Solution

```
1 ORG 0000H
2 MOV 65H, #0FOH      ; Store test data at 65H
3 MOV 75H, #0AAH      ; Store test data at 75H
4
5 MOV A, 65H          ; Load data from 65H to accumulator
6 ORL A, 75H          ; OR with data at 75H
7 MOV R6, A            ; Store result in R6 register
8 END
```

Operation Details:

- **Load**: First operand from memory location 65H
- **OR**: Perform logical OR with second operand at 75H
- **Store**: Result in R6 register

Example Calculation:

```
1 Data at 65H: FOH = 11110000B  
2 Data at 75H: AAH = 10101010B  
3 OR Result:   FAH = 11111010B
```

Mnemonic

“LOS - Load, OR, Store result”

Question 5(B) OR [4 marks]

Write An Assembly Language Program To Generate A Square Wave Of 2khz On P1.3. Crystal Frequency Is 11.0592 Mhz.

Solution

```
1 ORG 0000H  
2 MAIN:  
3     SETB P1.3          ; Set P1.3 high  
4     CALL DELAY_250US    ; Delay for half period  
5     CLR P1.3           ; Set P1.3 low  
6     CALL DELAY_250US    ; Delay for half period  
7     SJMP MAIN          ; Repeat continuously  
8  
9 DELAY_250US:  
10    MOV TMOD, #01H      ; Timer 0, Mode 1  
11    MOV TH0, #0FEH       ; Load high byte  
12    MOV TL0, #0CBH       ; Load low byte  
13    SETB TR0            ; Start Timer 0  
14 WAIT:  
15    JNB TFO, WAIT       ; Wait for overflow  
16    CLR TR0             ; Stop timer  
17    CLR TFO             ; Clear flag  
18    RET  
19 END
```

Calculation for 2KHz Square Wave:

```
1 Frequency = 2KHz, Period = 500µs  
2 Half Period = 250µs  
3  
4 Crystal = 11.0592 MHz  
5 Machine Cycle = 11.0592/12 = 0.921 MHz = 1.085µs  
6  
7 Timer Count = 250µs / 1.085µs = 230 cycles  
8 Timer Value = 65536 - 230 = 65306 = FECBH  
9 TH0 = FEH, TL0 = CBH
```

Square Wave Generation:

- **High Period:** Set pin high, wait 250µs
- **Low Period:** Set pin low, wait 250µs
- **Frequency:** $1/(250\mu s + 250\mu s) = 2\text{KHz}$

Mnemonic

“SCDW - Set high, Clear low, Delay, Wait”

Question 5(C) OR [7 marks]

Draw & Explain The Interfacing Of 7-Segment Display With 8051.

Solution

```
1 8051 to 7-Segment Display Interfacing
2
3 8051 Port 1           7-Segment Display
4 -----
5 P1.0 ----[R]----> a (Pin 7)
6 P1.1 ----[R]----> b (Pin 6)      aaaa
7 P1.2 ----[R]----> c (Pin 4)      f     b
8 P1.3 ----[R]----> d (Pin 2)      f     b
9 P1.4 ----[R]----> e (Pin 1)      gggg
10 P1.5 ----[R]----> f (Pin 9)     e     c
11 P1.6 ----[R]----> g (Pin 10)    e     c
12 P1.7 ----[R]----> dp (Pin 5)    dddd dp
13
14 [R] = Current limiting resistor Ω(330)
15
16 For Common Cathode:
17 Common pin (Pin 3,8) ---> GND
18
19 For Common Anode:
20 Common pin (Pin 3,8) ---> +5V
```

Display Configuration:

Character	Common Cathode Code	Common Anode Code
0	3FH	C0H
1	06H	F9H
2	5BH	A4H
3	4FH	B0H
4	66H	99H
5	6DH	92H
6	7DH	82H
7	07H	F8H
8	7FH	80H
9	6FH	90H

Sample Program:

```
1 ORG 0000H
2 MOV DPTR, #DIGIT_TABLE ; Point to lookup table
3 MOV A, #05H             ; Display digit 5
4 MOVC A, @A+DPTR        ; Get 7-segment code
5 MOV P1, A               ; Send to display
6 SJMP $                 ; Stay here
7
8 DIGIT_TABLE:
9 DB 3FH, 06H, 5BH, 4FH, 66H ; 0,1,2,3,4
0 DB 6DH, 7DH, 07H, 7FH, 6FH ; 5,6,7,8,9
1 ENDS
```

Interface Components:

- **Current Limiting Resistors:** 330Ω to limit LED current
- **Common Connection:** Cathode to GND or Anode to $+5V$
- **Data Lines:** 8 bits for segments a-g and decimal point

Multiplexing for Multiple Digits:

- **Digit Select:** Additional pins for digit selection
- **Time Division:** Rapidly switch between digits
- **Persistence of Vision:** Creates illusion of simultaneous display

Mnemonic

“CRAM - Common connection, Resistors limit, Address segments, Multiplex digits”