

# Microprocessor and Microcontroller (4341101) - Winter 2023 Solution

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## Question 1 [a marks]

3 Compare RISC and CISC.

### Solution

Answer:

Table 1. RISC vs CISC

Feature	RISC	CISC
Instructions	Simple, fixed-length	Complex, variable-length
Execution	Single cycle	Multiple cycles
Addressing modes	Few	Many
Registers	Many	Few
Design focus	Hardware simplicity	Code density

### Mnemonic

“RISCs Complete Instructions Simply”

## Question 1 [b marks]

4 Compare Von-Neumann and Harvard architecture.

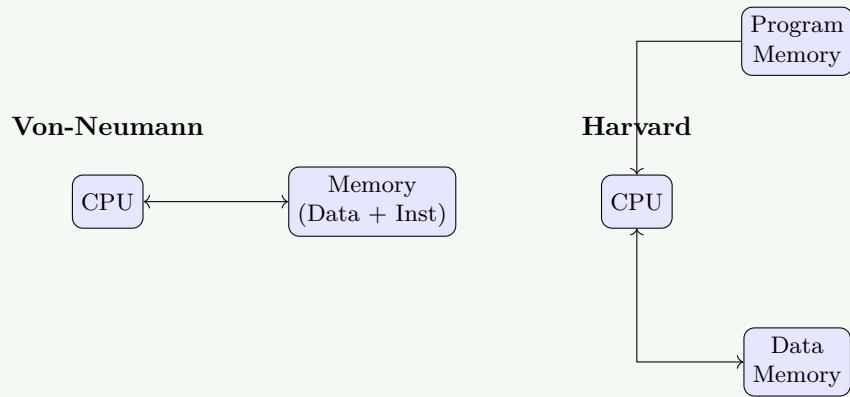
### Solution

Answer:

Table 2. Von-Neumann vs Harvard

Feature	Von-Neumann	Harvard
Memory	Single shared memory	Separate program & data memory
Bus	Single bus for data & instructions	Separate buses
Speed	Slower (memory bottleneck)	Faster (parallel access)
Complexity	Simpler design	More complex
Applications	General computing	Real-time systems

Diagram:

**Mnemonic**

"Harvard Has Separate Spaces"

## Question 1 [c marks]

7 Explain: 8085 Instruction Format, Control Unit, Machine Cycle, ALU

### Solution

**Answer:**

**1. Instruction Format:**

Opcode	Operand 1	Operand 2
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1-3 Bytes Total Length

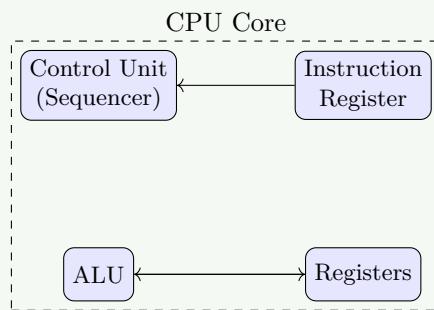
Contains opcode (3-8 bits) and 0-2 operands.

**2. Explanations:**

**Table 3. Components**

Component	Function
<b>Instruction Format</b>	1-3 byte structure with opcode and operands
<b>Control Unit</b>	Fetches, decodes instructions; generates signals
<b>Machine Cycle</b>	Basic operation cycle (T-states)
<b>ALU</b>	Performs arithmetic and logical operations

**3. Diagram:**



**Mnemonic**

“CIMA: Control Interprets, Machine Acts”

**OR**

## Question 1 [c marks]

7 Compare Microprocessor and Microcontroller.

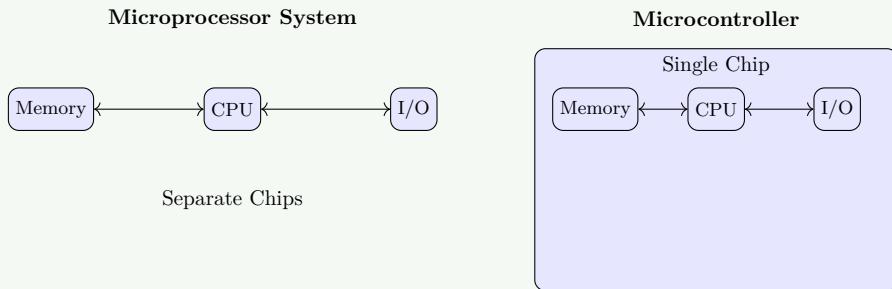
### Solution

**Answer:**

**Table 4.** Microprocessor vs Microcontroller

Feature	Microprocessor	Microcontroller
<b>Design</b>	CPU only	CPU + peripherals
<b>Memory</b>	External	Internal (RAM/ROM)
<b>I/O ports</b>	Limited	Many built-in
<b>Cost</b>	Higher	Lower
<b>Applications</b>	General computing	Embedded systems
<b>Power</b>	Higher	Lower
<b>Example</b>	Intel 8085/8086	Intel 8051

**Diagram:**



### Mnemonic

“Micro-P Processes, Micro-C Controls”

## Question 2 [a marks]

3 Explain Instruction Fetching, Decoding and Execution Operation in microprocessor.

### Solution

**Answer:**

**Table 5.** Operation Phases

Phase	Operation
<b>Fetching</b>	CPU gets instruction from memory using PC
<b>Decoding</b>	Determines operation type and operands
<b>Execution</b>	Performs the actual operation

Diagram:



### Mnemonic

“FDE: First Get, Then Understand, Finally Do”

## Question 2 [b marks]

4 Explain Bus Organization of 8085 microprocessor.

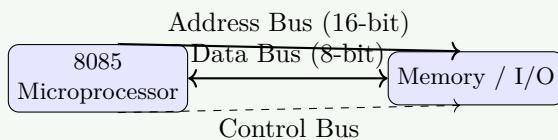
### Solution

Answer:

Table 6. 8085 Buses

Bus Type	Width	Function
<b>Address Bus</b>	16-bit	Carries memory addresses (A0-A15)
<b>Data Bus</b>	8-bit	Transfers data (D0-D7)
<b>Control Bus</b>	Various	Manages data flow (RD, WR, IO/M)
<b>Multiplexed</b>	AD0-AD7	Lower address bits + data bits

Diagram:



### Mnemonic

“ADC: Address points, Data flows, Control directs”

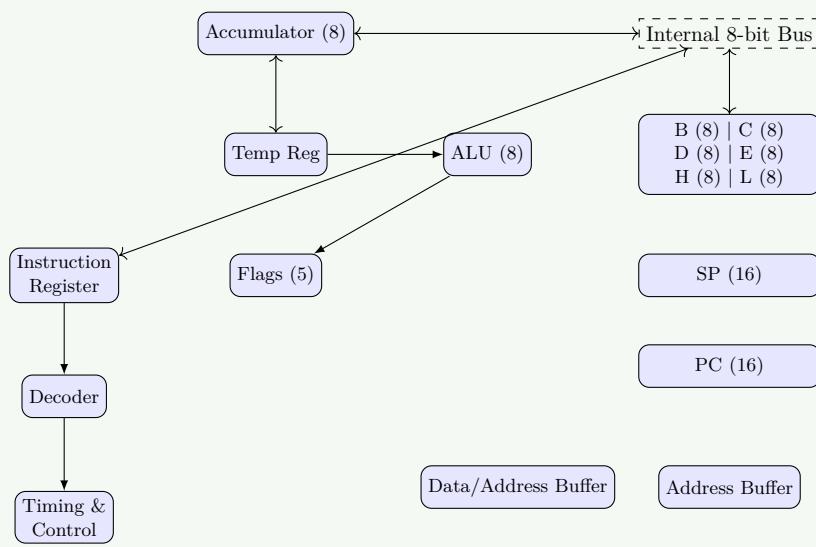
## Question 2 [c marks]

7 Describe architecture of 8085 microprocessor with the help of neat diagram.

### Solution

Answer:

Diagram:



- **ALU:** Performs arithmetic & logical operations
- **Registers:** Store data temporarily (A, B, C, D, E, H, L)
- **Control Unit:** Fetches & decodes instructions
- **PC:** Points to next instruction address
- **SP:** Points to top of stack

### Mnemonic

“ARCBD: Architecture Registers Control Buses Data”

OR

### Question 2 [a marks]

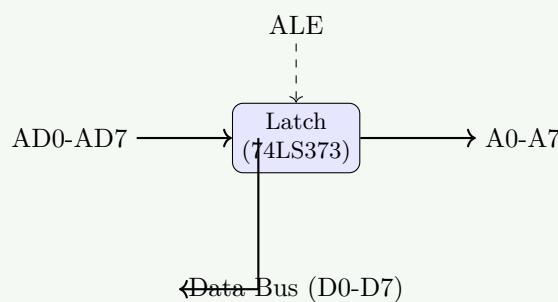
3 Explain De-multiplexing of Address and Data buses for 8085 Microprocessor.

### Solution

#### Answer:

1. **ALE High:** Lower address (A0-A7) appears on AD0-AD7 lines. Latch captures it.
2. **ALE Low:** AD0-AD7 lines are used for Data (D0-D7).

#### Diagram:



### Mnemonic

“ALAD: ALE Latches Address before Data”

OR

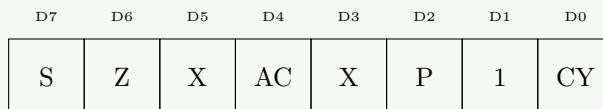
## Question 2 [b marks]

4 Draw Flag Register of 8085 microprocessor & explain it.

### Solution

**Answer:**

Flag Register (8-bit):



- **S (Sign):** Set if D7 is 1 (Negative result)
- **Z (Zero):** Set if result is zero
- **AC (Auxiliary Carry):** Carry from D3 to D4
- **P (Parity):** Set if result has even number of 1s
- **CY (Carry):** Carry out from D7

### Mnemonic

“SuZie AC’s Perfect CarrY”

OR

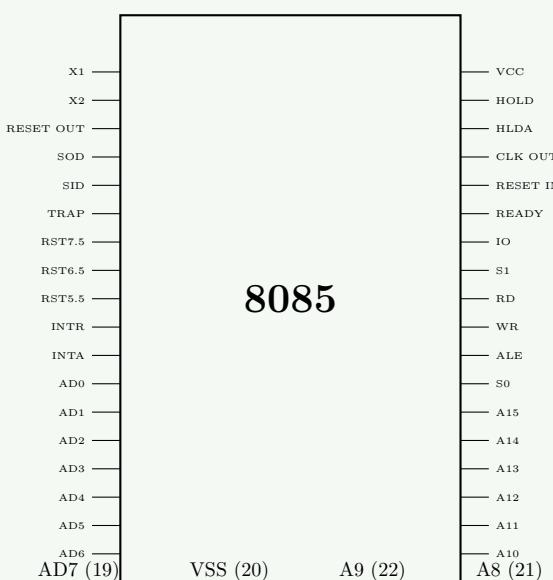
## Question 2 [c marks]

7 Describe Pin diagram of 8085 microprocessor with the help of neat diagram.

### Solution

**Answer:**

Pin Diagram:



- **Address/Data:** Multiplexed AD0-AD7, A8-A15
- **Control:** RD, WR, IO/M, ALE
- **Interrupts:** TRAP, RST 7.5/6.5/5.5, INTR
- **Power:** VCC (+5V), VSS (GND)

**Mnemonic**

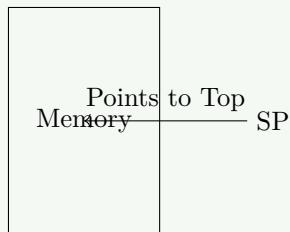
“ACID-PS: Address-Control-Interrupt-DMA-Power-Serial”

### Question 3 [a marks]

3 Explain Stack, Stack Pointer and Stack operation.

**Solution****Answer:**

- **Stack:** Reserved area of RAM used for temporary storage (LIFO).
- **Stack Pointer (SP):** 16-bit register holding address of top of stack.
- **PUSH:** Decrement SP, Store data.
- **POP:** Retrieve data, Increment SP.

**Diagram:**

LIFO: Last In First Out

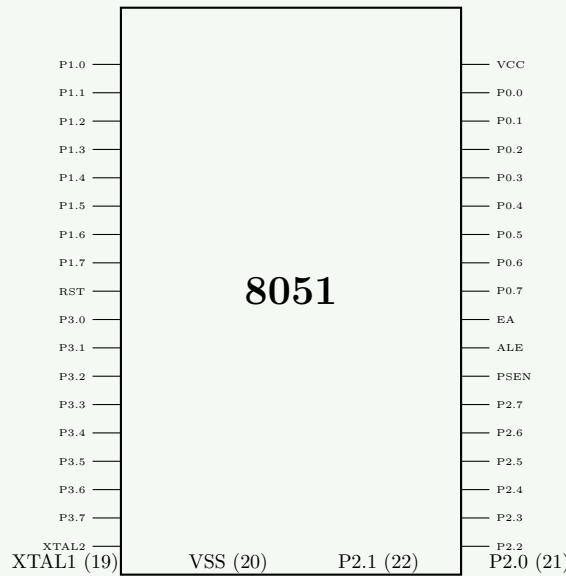
**Mnemonic**

“SP Points to LIFO Lane”

### Question 3 [b marks]

4 Draw Pin diagram of 8051 microcontroller.

**Solution****Answer:**



- **P0:** Multiplexed Address/Data
- **P1:** General I/O
- **P2:** High Order Address
- **P3:** Special Functions (Serial, Int, Timer)

### Mnemonic

“PORT 0123: Data-General-Address-Special”

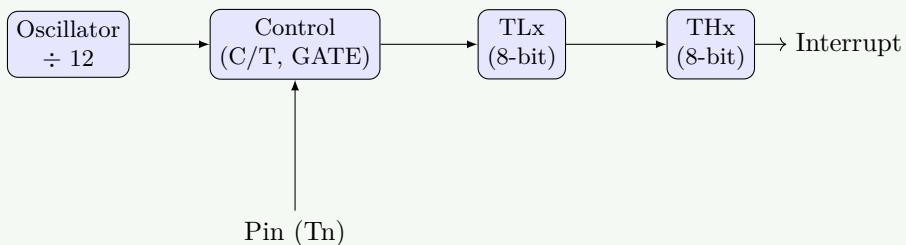
## Question 3 [c marks]

7 Draw Timers/Counters logic diagram of 8051 microcontroller and explain its operation in various modes.

### Solution

**Answer:**

**Logic Diagram:**



**Modes:**

- **Mode 0:** 13-bit timer mode.
- **Mode 1:** 16-bit timer mode.
- **Mode 2:** 8-bit auto-reload mode.
- **Mode 3:** Split timer mode.

### Mnemonic

“MARC: Mode Auto-Reload Count”

OR

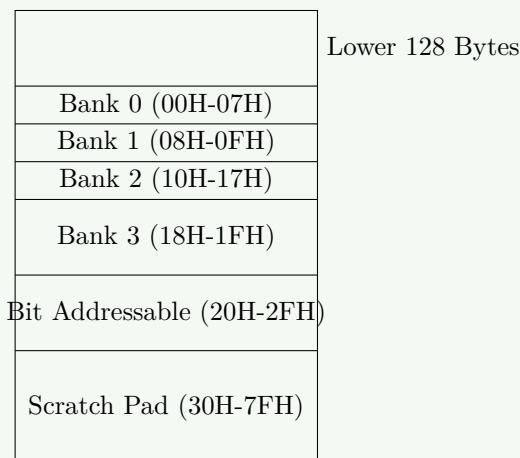
**Question 3 [a marks]****3 List Common features of Microcontrollers.****Solution****Answer:****Table 7. MCU Features**

<b>Feature</b>	<b>Purpose</b>
<b>CPU Core</b>	Process instructions
<b>Memory</b>	Store program (ROM) and data (RAM)
<b>I/O Ports</b>	Interface with external devices
<b>Timers</b>	Measure time intervals
<b>Interrupts</b>	Handle asynchronous events
<b>Serial Comm</b>	Transfer data with other devices

**Mnemonic**

“CRITICS: CPU ROM I/O Timers Interrupts Comm Serial”

OR

**Question 3 [b marks]****4 Explain Internal RAM Organization of 8051 microcontroller.****Solution****Answer:**

- **Register Banks (00H-1FH):** 4 banks of 8 registers (R0-R7).
- **Bit Addressable (20H-2FH):** 16 bytes where each bit can be accessed.
- **Scratch Pad (30H-7FH):** General purpose RAM.
- **SFRs (80H-FFH):** Special Function Registers (upper 128 bytes).

**Mnemonic**

“RBBS: Registers Bits Buffer Scratch”

**OR**

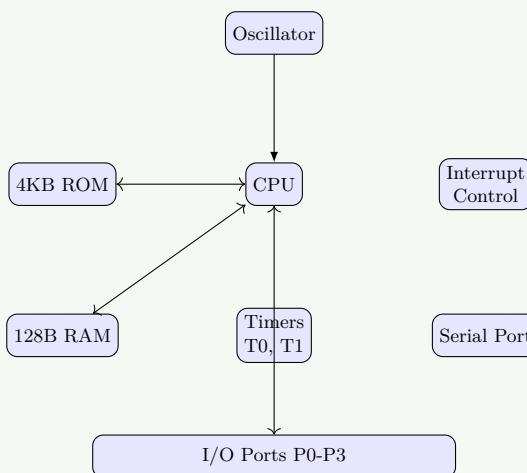
**Question 3 [c marks]**

7 Explain architecture of 8051 microcontroller with the help of neat diagram.

**Solution**

**Answer:**

**Diagram:**



- **CPU:** 8-bit central processor.
- **Memory:** 4KB ROM (Code), 128B RAM (Data).
- **I/O:** 4 Ports (P0-P3).
- **Timers:** 2 16-bit timers.
- **Serial:** 1 UART channel.
- **Interrupts:** 5 sources.

**Mnemonic**

“CAPITALS: CPU Architecture Ports I/O Timer ALU LS-Interface Serial”

**Question 4 [a marks]**

3 Write an 8051 Assembly Language Program to Copy the data from external RAM Location 0123h to TL0 and Data from external RAM location 0234h to TH0.

**Solution**

**Answer:**

```

1 MOV DPTR, #0123H ; Load DPTR with source address 0123H
2 MOVX A, @DPTR      ; Read data from external RAM
3 MOV TL0, A          ; Copy to Timer 0 low byte
4
5 MOV DPTR, #0234H ; Load DPTR with source address 0234H
  
```

```

6 MOVX A, @DPTR      ; Read data from external RAM
7  MOV TH0, A        ; Copy to Timer 0 high byte

```

**Mnemonic**

“DRAM: DPTR Read Address Move”

**Question 4 [b marks]**

4 Write an 8051 Assembly Language Program to blink LED interfaced at port P1.3 at time interval of 1ms.

**Solution****Answer:**

```

1 AGAIN: SETB P1.3      ; Turn ON LED at P1.3
2      ACALL DELAY     ; Call delay subroutine
3      CLR P1.3         ; Turn OFF LED at P1.3
4      ACALL DELAY     ; Call delay subroutine
5      SJMP AGAIN       ; Repeat forever
6
7  DELAY: MOV R7, #250    ; Load R7 for outer loop
8  OUTER: MOV R6, #1      ; Load R6 for inner loop
9  INNER: DJNZ R6, INNER  ; Decrement R6 until zero
10     DJNZ R7, OUTER    ; Decrement R7 until zero
11     RET                ; Return from subroutine

```

**Mnemonic**

“STACI: Set-Timer-And-Clear-Ininitely”

**Question 4 [c marks]**

7 List Addressing Modes of 8051 Microcontroller and explain all of them with the help of example.

**Solution****Answer:**

**Table 8.** Addressing Modes

Addressing Mode	Example	Description
Immediate	MOV A, #25H	Data is in instruction
Register	MOV A, R0	Data is in register
Direct	MOV A, 30H	Data is at RAM address
Indirect	MOV A, @R0	R0/R1 contains address
Indexed	MOVC A, @A+DPTR	Access program memory
Bit	SETB P1.3	Access individual bits
Relative	SJMP LABEL	Jumps with 8-bit offset

**Mnemonic**

“I'M DIRBI: Immediate Register Direct Bit Indexed”

**OR**

**Question 4 [a marks]**

3 Write an 8051 Assembly Language Program to Subtract the content of RAM location 11h from RAM location 14h; put result in RAM location 3Ch.

**Solution****Answer:**

```

1 MOV A, 14H      ; Load content of RAM location 14H to A
2 CLR C          ; Clear carry flag
3 SUBB A, 11H    ; Subtract content of 11H with borrow
4 MOV 3CH, A     ; Store result in RAM location 3CH

```

**Mnemonic**

“LCSS: Load-Clear-Subtract-Store”

**OR**

**Question 4 [b marks]**

4 Write an 8051 Assembly Language Program to generate a square wave of 50% duty cycle on bit 3 of Port 1 using Timer 0 in Mode 1.

**Solution****Answer:**

```

1 MOV TMOD, #01H    ; Timer 0, Mode 1 (16-bit)
2 AGAIN: MOV TH0, #0FCH  ; Load high byte
3     MOV TL0, #18H    ; Load low byte (-1000 in 16-bit)
4     SETB TR0        ; Start timer
5     JNB TFO, $       ; Wait for overflow
6     CLR TR0        ; Stop timer
7     CLR TFO        ; Clear timer flag
8     CPL P1.3        ; Toggle P1.3
9     SJMP AGAIN      ; Repeat

```

**Mnemonic**

“MSTCCS: Mode-Set-Timer-Check-Clear-Switch”

**OR**

**Question 4 [c marks]**

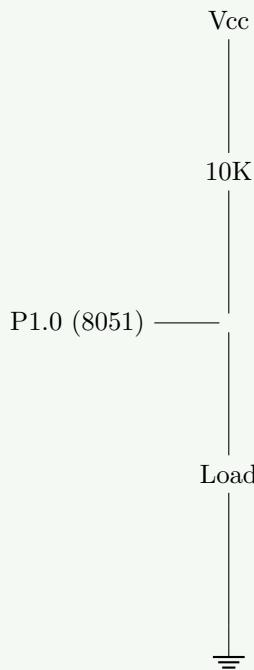
7 Explain any seven Logical Instructions with example for 8051 Microcontroller.

**Solution****Answer:****Table 9.** Logical Instructions

Instruction	Example	Operation
<b>ANL</b>	ANL A, #3FH	Logical AND
<b>ORL</b>	ORL P1, #80H	Logical OR
<b>XRL</b>	XRL A, R0	Logical XOR
<b>CLR</b>	CLR A	Clear (set to 0)
<b>CPL</b>	CPL P1.0	Complement (invert)
<b>RL</b>	RL A	Rotate left
<b>RR</b>	RR A	Rotate right

**Mnemonic**

“A-OX-CCR: AND OR XOR Clear Complement Rotate”

**Question 5 [a marks]****3 Draw Interfacing of Push button Switch with 8051 microcontroller.****Solution****Answer:****Diagram:**

- **Pull-up Resistor:** Keeps pin HIGH when button is open.
- **Button Press:** Pulls pin LOW.

**Mnemonic**

"PIP: Pull-up-Input-Press"

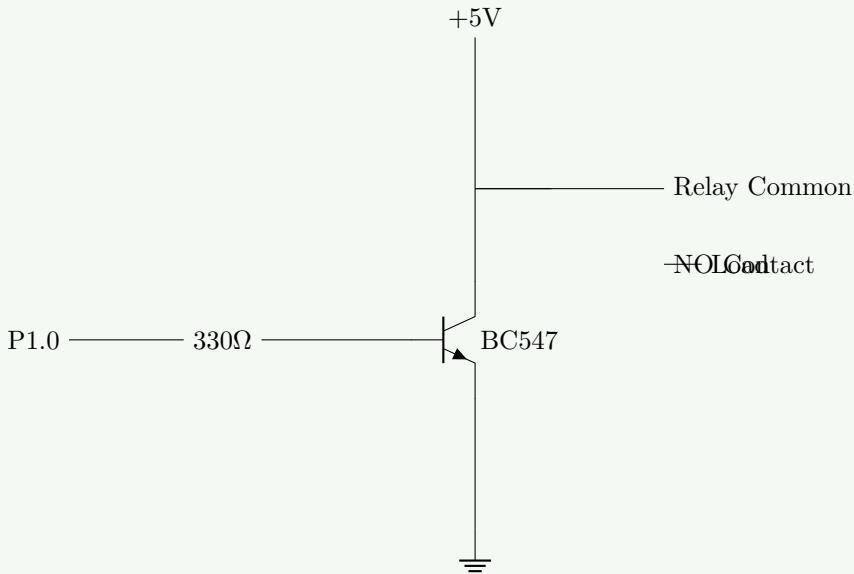
**Question 5 [b marks]**

4 Interface Relay with 8051 microcontroller.

**Solution**

**Answer:**

**Diagram:**

**Mnemonic**

"TRIP: Transistor-Relay-Interface-Protection"

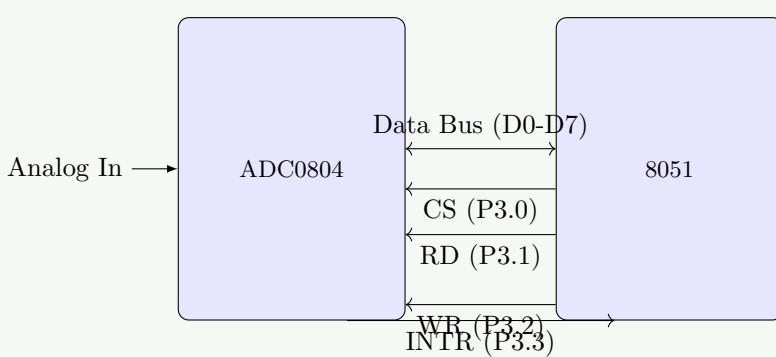
**Question 5 [c marks]**

7 Interface ADC0804 with 8051 microcontroller.

**Solution**

**Answer:**

**Diagram:**



- **Data Bus:** P1.0-P1.7 connected to D0-D7.
- **Control:** RD, WR, INTR for handshaking.

**Mnemonic**

“CRIW: Control-Read-Interrupt-Write”

**OR**

**Question 5 [a marks]**

3 List Applications of microcontroller in various fields.

**Solution**

**Answer:**

**Table 10.** Applications

Field	Applications
Industrial	Motor control, automation, PLCs
Medical	Patient monitoring, diagnostic equipment
Consumer	Washing machines, microwaves, toys
Automotive	Engine control, ABS, airbag systems
Communication	Mobile phones, modems, routers
Security	Access control, alarm systems

**Mnemonic**

“I-MACS: Industrial-Medical-Automotive-Consumer-Security”

**OR**

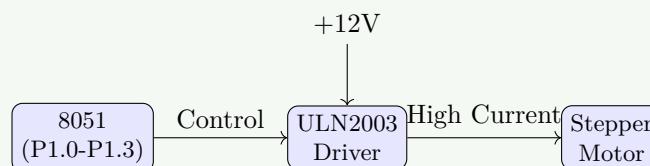
**Question 5 [b marks]**

4 Interface Stepper motor with 8051 microcontroller.

**Solution**

**Answer:**

**Diagram:**



**Sequence (Clockwise):** 0x08, 0x0C, 0x04, 0x06.

**Mnemonic**

“PDCS: Port-Driver-Current-Sequence”

OR

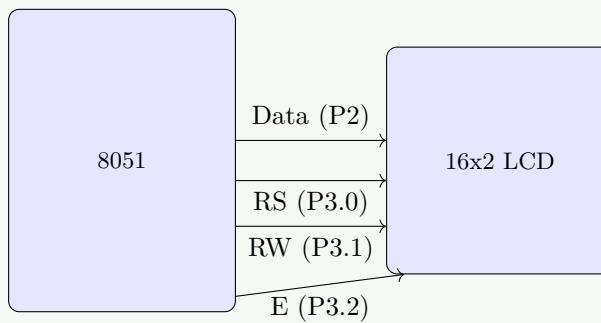
## Question 5 [c marks]

7 Interface LCD with 8051 microcontroller.

### Solution

Answer:

Diagram:



- **Data:** Port 2 sends ASCII data/commands.
- **RS:** 0 for Command, 1 for Data.
- **E:** Enable Pulse to latch data.

### Mnemonic

“DICE: Data-Instruction-Control-Enable”