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COA Assignment 1

Q1 List and briefly define the main structural components of a computer.

Sol^n The main structural components of a computer are.

- CPU (Central processing unit) : It controls the operation of the computer and performs its data processing function. It is also known as processor.
- Main Memory : It stores Data.
- I/O : Moves data between the computer and its external environment
- System Bus : It is used for interconnection between I/O, CPU, Main Memory. It consists of a number of conducting wire to which all the other component attach.

Q2 Explain ARM architecture and briefly describle the different ARM product.

Sol^n The ARM architecture refers to a processor architecture that has evolved from RISC design principles and is used in embedded systems.

ARM chips are high speed processors and known for their small die size and low powered requirment.

They are widely used in smartphones, game systems, Apple's ipod, iphone devices.

ARM products

1. CORTEX-A: They are application processors, they run at higher clock frequency, they support a MMU which is required for full feature OS. It is a 32 bit machine.

2. CORTEX-R: It is designed to support real-time applications, in which the timing of events needs to be controlled with rapid response to events. They run at a higher clock frequency and have a very low response latency.

3. CORTEX-M: They have been developed primarily for the microcontroller domain where the need for fast, highly deterministic interrupt management is coupled with the desire for extremely low gate count and lowest possible power consumption. They have MPU but no MMU.

Q.4 Explain the architecture of 8086 processor.

Soln
- It is a 40 pin dual in line package IC.
- It is a 16 bit microprocessor.
- 8086 processor has 20 bit address bus and can access upto 2^{20} (1MB) memory locations.
- It can support upto 64K I/O ports.
- It provides 14, 16-bit registers.
- It has multiplexed address and data bus AD0-AD15 and A16-A19

- It requires +5V power supply.
- It can pre-fetch upto instruction bytes from memory and queue them in order to speed up instruction execution.
- It requires single phase clock with 33% duty cycles to provide internal timing.

Q3 Differentiate between
i) Microprocesor and Microcontroller
ii) CISC and RISC
iii) Embedded system and Deeply Embedded System.

Soln i)

Microprocessor	Microcontroller.
• It is the heart of computer system.	• It is the heart of embedded system
• It is just a procesor memory & I/O components have tee be connected externally.	• It has procesor along with internal memory & I/O components.
• Since Memory & I/O has to be connected externally the circuit becomes large.	• Since memory & I/O are present internally, the circuit is small.
• It cannot be used in compact systems & hence inefficient.	• It can be used in compact system and hence it is an efficient technigue.
• They have less no of registers.	• They have more no of registers.
• They are based on Von Neumann model architecture.	• They are based on Harvard architecture.

ii

CISC	RISC
• Stands for Complex Instruction set computers	• Stands for Reduced Instruction set computers.
• Hardware centric design	• Software centric design
• Instruction cycles can take several clock cycles to execute	• Single cycle instruction takes place.
• Pipelining is difficult	• Pipelining is easy.
• It uses less registers.	• It uses more registers.
• It is based on Von Neumann architecture	• It is based on Harvard architecture.

iii

Embedded System	Deeply Embedded System
• It is a microprocessor based computer system that is designed to perform a dedicated function.	• They are dedicated, single purpose devices.
• They are optimised for energy, code, size, execution, time, weights dimension and cost.	• They have extreme resource constraints in terms of memory, processor size, time and power consumption.

5) Find the memory address of the next instruction executed by the microprocessor (8086), when operated in real mode for CS = 1000 and IP = E000

Soln Memory Address = CS × 10 + IP

= 1000 × 10 + E000

= ~~10E~~ 1E000

6)

Soln $$CPI = \frac{\sum_{i=1}^{n} (CPI_i \times I_i)}{I_c}$$

$$= \frac{(1 \times 45000) + (2 \times 32000) + (2 \times 15000) + (2 \times 8000)}{100000}$$

$$= 1.55$$

$$\text{MIPS rate} = \frac{f}{CPI \times 10^6} = \frac{40 \times 10^6}{1.55 \times 10^6} = 25.8$$

$$\text{Execution time} = I_c \times CPI \times 2$$

$$= 10^5 \times 1.55 \times \frac{1}{40 \times 10^6}$$

$$= 3.875 \text{ ms}$$

Ans = Option B

CPI : 1.55; MIPS : 25.8 ; Execution Time = 3.87

Q7
Soln

$$\text{No of instruction} = \frac{\text{Total time}}{\text{CPI}} \times \text{Clock frequency}$$

Total time ratio :- P1 : P2 = 100 : 75 = 4 : 3

CPI ratio :- CPI1 : CPI2 = 100 : 120 = 5 : 6

$$\frac{P1}{CPI1} \times f_1 = \frac{P2}{CPI2} \times f_2$$

$$\frac{P1 \times CPI2}{P2 \times CPI1} \times f_1 = f_2$$

$$\frac{4}{3} \times \frac{6}{5} \times 1 = f_2$$

$$f_2 = 1.6\ GHz$$

Q8
Soln

	Computer A	Computer B	Computer C
Program 1	50	20	10
Program 2	100	200	40

MIPS rate $= \left(\frac{Ic}{T \times 10^6}\right)$

	Computer A	Computer B	Computer C
MIPS Program 1	0.2	0.5	1
MIPS Program 2	0.1	0.05	0.25
AM rate	0.15	0.275	0.625
HM rate	0.133	0.09	0.4

AM rate: Comp C < comp B < comp A

HM rate : Comp C < Comp A < comp B.

Q 9 $I_c = 100000 = 10^5$ $f = 400 \times 10^6$ Hz

Machine A

$$CPI = \frac{(0.50 \times 10^5 \times 2) + (0.15 \times 10^5 \times 3) + (0.15 \times 10^5 \times 4) + (0.20 \times 10^5 \times 2)}{10^5}$$

$$= 2.45$$

$$MIPS = \frac{f}{CPI \times 10^6} = \frac{400 \times 10^6}{2.45 \times 10^6} = 163.26$$

Execution time = $I_c \times CPI \times 2$

$$= 2.45 \times 10^5 \times \frac{1}{400 \times 10^6}$$

$$= 0.61 \text{ ms}$$

Machine B

$$CPI = \frac{(0.65 \times 10^5 \times 1) + (0.15 \times 10^5 \times 4) + (0.10 \times 10^5 \times 3) + (0.10 \times 10^5 \times 2)}{10^5}$$

$$= 1.75$$

$$MIPS = \frac{400 \times 10^6}{1.75 \times 10^6} = 228.57$$

Execution time = $1.75 \times 10^5 \times \frac{1}{400 \times 10^6}$

$$= 0.43 \text{ ms}$$