1. A server is to be equipped with a new CPU. The new CPU is three times faster than the older CPU. Assume that the old CPU spends **45**% of the time doing computations, and for the rest is waiting for I/O requests. Calculate the speedup which can be achieved with the new CPU.

[5 marks]

2. Assume a program **P** is implemented for two microprocessors, **A** and **B**. The table below shows the number of instructions required by each microprocessor to run the same program **P**:

Instructions	µP A	µP B
Integer addition	1	9
Integer multiplication	2	3
Load word	15	6
Store word	12	1
Jump	4	1
fp addition	2	3
fp subtract	4	3
fp multiplication	4	3
fp trigonometric	1	1

Each instruction requires the following number of cycles under each microprocessor, as given in the table below:

Instructions	# Cycles under µP A	# Cycles under µP B
Integer addition	1	2
Integer multiplication	12	20
Load word	3	4
Store word	4	4
Jump	3	2
fp addition	5	7
fp subtract	5	7
fp multiplication	6	12
fp trigonometric	45	70

The clock speed of processor A is 10 MHz, while processor B is 12 MHz.

a) Why does one of the processors need much more instructions to execute the same program?
b) Calculate is the CPI for each processor?
c) Which processor executes the program faster?
d) How many MIPS are achieved by the processors for the program execution?
e) How many MFLOPS are achieved by the processors for the program execution?

[3+4+4+5+4 marks]

3. Answer briefly the following questions:
   a. Why is MIPS not an accurate measure for comparing performance among computers?
   b. What are the benefits of benchmarks compared to plain information about hardware like MHz?

[3+3 marks]

4. Assume a 15 cm diameter wafer has a cost of 12,000 rupees and giving 80 dies with 0.2 defects per cm^2. Another 20 cm diameter wafer has a cost of 15,000 rupees and can produce 100 dies with 0.3 defects per cm2. Assuming a wafer yield of 92% and *alpha* = 3:

   a. calculate the die yield for both wafers.
   b. calculate the cost per good die for both wafers.
   c. if the number of dies is increased by 10% and the defect density increases by 15%, calculate the new die area and yield.
   d. assume a fabrication enhancement improves the wafer yield to 95%, find the defects per unit area for each wafer given that the die area is 200 mm^2.

[4+4+5+5 marks]

5. Consider an embedded system with 4 kilobytes of RAM, a tiny 128 bytes, **direct-mapped** cache with 32 bytes cache line. You can assume that the cache is initially empty. Indicate where in cache are the eight consecutive memory references mapped and whether they are hit or miss.

Memory Reference (in Hex)	Cache Hit or Miss	Tag	Index/Line
1. 070			
2. 080			
3. 068			
4. 190			
5. 084			
6. 178			
7. 08C			
8. F00			

[8x2 marks]

6. How much time is required to process 7,777 operations in a pipeline with 7 equal stages and an execution time of 7 ms per stage?

[5 marks]

7. Two microprocessors A and B both have clock speeds of 333MHz. On processor A with a CPI of 2.5, a program P requires $9x10^6$ instructions whereas on processor B with a CPI of 3, the same program P requires $7x10^6$ instructions. Which processor is faster and by how much?

[6+4 marks]

Total Marks: 80
Module weight: 40%

*** END ***

Deliverables:
Email me your answers as an attachment with filename: ctrl_ass_[your_index_number].doc or .pdf at bee21bft@rishiheerasing.net before **Sunday 12th Feb 2023 by 19:00 Hrs** (local time)