CCE1011 Introduction to Computer Systems

Tutorial No 2 Microprocessor Operations

1. Describe the fetch and execute cycle of a simple processor, and its relation to the special registers inside the processor

2. Is the internal data bus inside the processor available as pins on the processor chip? Give reasons for your answer.

3. Starting from the slower devices to the faster give a list and typical data transfer values between the processor and peripheral. The answer must clearly show the value.

4. Convert : (i) 35ms to nanoseconds (ns) - microseconds (us) - seconds (s)

5. A von Neumann machine has both data and instructions as binary inside the program memory. How does the processor distinguish an instruction operand from a data operand?

6. A program can have within it a procedure call which is executed before returning to continue the program. What operations are necessary to ensure proper continuation of the program after the procedure is executed?

7. How is a hardware interrupt initiated? Why are interrupts important in a processor system?

8. Describe the function of a priority interrupt controller. Describe how in a multiperipheral environment, each requiring interrupt service, a particular peripheral's interrupt is distinguished and recognised.

9. A processor operates at a clock of 10 GHz. Accessing main memory takes 100ns. An input/output routine program prepares a list of byte characters for output to the printer. The routine consists of fifty instructions used to initialise the transfer of the characters. Characters are transferred to the printer buffer from memory. The printer buffer can take fifty characters. Assume that the characters are transferred at main memory speed. The printing starts once the buffer is full, and printing of one character takes 1 ms. When it finishes printing the fifty characters, the printer raises an interrupt. The interrupt service routine uses ten instructions, which either calls again the byte transfer routine or finishes the printer service. There is a block of 800 characters in memory, to print.

   Calculate the time taken for the block to print. State any assumptions made.

10. A benchmark program has the following instruction mix.

		Clock Cycles per Instruction
Integer Arithmetic	42,000	1
Floating Point	30,000	3
Data Transfer	22,000	2
Control transfer	6,000	4

The processor clock operates at 10GHz. Calculate:

(i) The average clocks per cycle, CPI
(ii) The millions of instructions per second MIPS
(iii) The time to execute the program.

11. In modern machines there can be a number of processors. Assume a machine with ten processors. For a given program 60% of the instructions can be run in parallel while the rest in series. Calculate the speed-up theoretically possible on this system.

12. Three machines run four benchmark programs, A, B, C, D. The execution time, in seconds, on the two machines are the following

	Machine 1	Machine 2	Machine 3
A	5	10	20
B	200	20	30
C	100	100	80
D	550	400	800

For equal weighting of the programs calculate for each machine:
(i) The arithmetic mean (ii) the geometric mean.

13 Redo question 12 with the following weightings for the programs: A = 0.4, B = 0.3, C=0.2, D =0.1. The weightings imply the relative importance being given to each benchmark.

14 A CPU operates on a clock of 10GHz. Access to memory is five times slower than execution of an instruction. In a given benchmark 40% of instructions require one access to memory during execution. If an instruction without memory reference takes 2 clock cycles to execute, find the actual average clock cycles needed to execute the benchmark program. Hence calculate the MIPS rate.