CCE1011 Introduction to Computer Systems

Answer ANY FOUR questions

1. Write short notes on the following:
   (a) synchronous and asynchronous clock
   (b) short term scheduling by the operating system
   (c) priority interrupt controller
   (d) write policy when using cache memory
   (e) instruction fetch in today's CPU's

   ` (25 marks)

2. a) Four benchmark programs are executed on three computers. In each case the execution time, in seconds, was measured. Each program had 100,000,000 instructions.

	Computer A	Computer B	Computer C
Program 1	1	10	20
Program 2	100	100	20
Program 3	500	1000	50
Program 4	100	800	100

Table 1

Calculate the average MIPS for each computer using the suite of four programs. (10 marks)

b) A 256 X 1 bit RAM IC is to be used in building a 1024 X 8 memory bank

   (i) How many IC's are necessary? (3 marks)
   (ii) Sketch the memory making use appropriately of a suitable decoder, chip enables and IC banks. Describe briefly your sketch. (8 marks)
   (iii) For your sketch show via the decoder which bank is used to access the data from address 345. (4 marks)

3. A small computer has a main memory with 16 address bits. Addressing is to the byte level.
   The cache has a capacity of 2K bytes. The block transfer between memory and cache is of 64 bytes. The cache uses a set associative organisation using 2 blocks per set.
   (i) How many bits are there in the TAG, SET and WORD fields. (6 marks)
   (ii) The following main memory blocks are to be transferred to cache. In each case the start address of the block, in hexadecimal, is given.
   AF80, AC80, CF00, CFC0.
   For each address work out the value of the tag and the set fields, in decimal. (16 marks)

Do the four main memory blocks map to different sets? Give reasons for your answer. (3 marks)

4. (a) Distinguish between the use of contiguous memory allocation and page allocation schemes for memory management. In each case mention what extra information is required within the CPU to be able to have proper program execution. (5 marks)
(b) The page table of the process currently executing is given below, Table 2. All numbers are in decimal. All addresses are memory byte addresses. The page size is 1024 bytes.
   (i) Describe how, in general, a virtual address presented to the CPU is translated into a physical memory address. (4 marks)
   (ii) What physical address, if any, would each of the following virtual addresses correspond to?
   1067; 2192; 2731; 4599 (16 marks)

Virtual Page Number	Valid Bit	Modify Bit	Physical Page Frame Number
0	1	0	4
1	1	1	7
2	0	0	-
3	1	0	2
4	0	0	-
5	1	0	0

Table 2

5. (a) A hard disk drive volume has 12 surfaces and has 10,000 tracks. Each track has 400 sectors, with 512 bytes per sector.
   (i) Calculate the volume data capacity in Megabytes. (3 marks)
   (ii) Suggest a suitable address format for the disk volume (5 marks)
   (iii) A data base uses records of 420 bytes. The database has 10,000 records. How much space does the database occupy on the disk if each record is individually accessible from the disk volume. (3 marks)
(b) A computer has 1024 characters to be transferred and printed using a printer having a buffer of 256 bytes. The main memory transfer time is 5 ns per byte. The printer accepts a full buffer, or the last buffer, and then prints. Printing a buffer takes 50 ms. The transfer is via a DMA IC. The setting up of the DMA requires 1ms of instruction executions. This is also required every time the printer buffer is to be reloaded.
   (i) Starting from the first initiation of the interrupt service routine, how long does it take to print all the characters. (8 marks)

(ii) The CPU on average takes 2 ns to execute an instruction. How many instructions does the CPU execute while the DMA is managing the transfer. (6 marks)

In both cases state any assumptions made in your calculations.