

Introduction to Computer Systems CCE1011

January 2012

Answer any FOUR questions

- 1 Describe briefly the meaning and use of each of the following:
- (I) Isochronous operation
 - (ii) Write Policy for Cache Memory
 - (iii) Vectored Interrupt Operation
 - (iv) Address of a sector on a Hard Disk Drive
 - (v) Translation Look Aside Buffer
- (25 marks)
- 2 (a) A computer system uses 256 Kilobyte of Main memory organised on a byte address, and 512 Byte of cache memory organised as 128 lines, (addresses) of 32 bits each. The transfer between main memory and cache is a block of 64 bytes Cache is organised into sets with 2 blocks per set.
- (i) Work out the number of bits in each of the TAG, SET and WORD fields of a main Memory address. (9 marks)
 - (ii) A program in main memory starts at address 0 and is 576 bytes long. The program is executed three consecutive times. If cache memory is five times faster than main memory, calculate the percentage increase in efficiency when using cache and main memory. Assume an Most Recently Used, (MRU) replacement algorithm in the cache. (16 marks)
3. (a) A test programme is used on a processor. The program is 1,000,000 instructions long. The instruction mix is as follows

Type	Number	Clock Cycles
Arithmetic	500,000	2
Logic	100,000	1
Floating-Point	250,000	3
Decision	150,000	4

Program execution time is 5.32 milliseconds. For the processor calculate

- (i) the CPU clock speed in GHz (5 marks)
 - (ii) the average clocks per instruction, CPI, for the programme (5 marks)
 - (iii) the average MIPS (5 marks)
- (b) A DRAM Integrated circuit consists of 64K addresses by 1 bit. The address bus from the processor is connected directly to the RAM.
- (i) How many pins are necessary on the IC? Give reasons for your answer. (5 marks)
 - (ii) These IC's are to be used to build up a 512 KByte memory. How many memory IC's are necessary to do this using the 64K 1-bit IC's? Give reasons for your answer. (5 marks)

- 4 (a) Define the parameters that need to be considered when working out the access time from main memory to a hard disk drive read or write. (5 marks)
- (b) Distinguish between RAID Levels 0,1, and 2. (6 marks)
- (c) A Hard Disk Drive, HDD, uses sectors of 1024 bytes. 12 bytes are for address and control and the rest are for data. A database uses data records of fixed length, each record being 264 bytes long. The database has 3000 records. It is to be stored on the HDD mentioned above.
- (i) Calculate the number of disk sectors necessary to store the database on the HDD and ensure that each record is available in one disk access. (6 marks)
- (ii) For your answer, calculate the percentage efficiency of the HDD using

$$\frac{\text{Total bytes used on HDD} - \text{Actual bytes used for data}}{\text{Total bytes used on HDD}} \times 100\%$$

State any assumptions made. (8 marks)

- 5 (a) Mention two extra registers necessary in the CPU for proper operation and security in a multiuser, contiguous allocation, memory. In each case explain their use. (5 marks)
- (b) A system uses a 48-bit virtual memory address space. It uses a paged memory operating system with pages of 2 KByte each on a physical memory of 256 Gigabytes.
- (i) How many bits are necessary in the Translation Lookaside buffer for a virtual page entry and for a physical page entry (4 marks)
- (c) A user page table is shown in figure 1, below.

NA
21
47
NA
5
12
84
NA

^ NA means virtual page not in user page table

Figure 1

The following addresses, in hexadecimal, are generated from a virtual program that has the user page table of Figure 1 above. The user page table entries are also in hexadecimal. The system uses a virtual memory space of 2^{20} addresses. Virtual and Physical pages are 256 bytes long. The physical memory is 64 Megabytes.

For each of the four virtual addresses below, work out whether the virtual address is available in main memory, and if it is, calculate its physical location, in hexadecimal.

00078; 0015E; 00523; 01F2A. (16 marks)