

*Ollscoil na hÉireann, Gaillimh*  
*National University of Ireland, Galway*

GX 1607

**Semester II Examinations, 2002/2003**

Exam Code(s)	<u>2IF1</u>
Exam(s)	<u>Second Year Information Technology</u>
Module Code(s)	<u>CT213</u>
Module(s)	<u>Computer Systems and Organization</u>
Paper No.	<u>1</u>
Repeat Paper	<u></u>
External Examiner(s)	<u>Professor Paddy Nixon</u>
Internal Examiner(s)	<u>Professor G. Lyons</u>
	<u>Mr. P. Bigioi</u>

**Instructions:**

Answer any 4 questions.  
Use a separate answer book for each section.  
All questions will be marked equally.

Duration	<u>3 hrs</u>
No. of Answer Books	<u>2</u>
No. of Pages	<u>5</u>
Department(s)	<u>Information Technology</u>

## Section A (Questions 1 to 3)

### Question 1

- a) Describe briefly the main instruction types (data transfer, data operation and program control).

6 MARKS

- b) Describe at least five addressing modes currently used in modern processors.

9 MARKS

- c) Given a CISC processor with the architecture in the Figure 1, please describe the content of the main registers during the fetch-decode-execute cycle of instruction MOV AX,#3, located in the main memory at address 0x1002.

10 MARKS

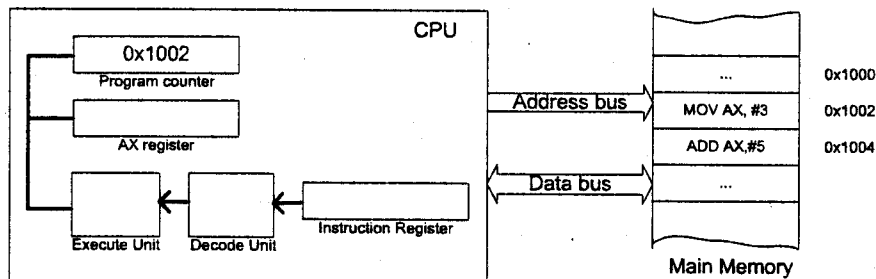


Figure 1: Fetch-Execute-Decode

### Question 2

- a) Represent number 7.5 using floating point IEEE 754 standard, in single precision format.

6 MARKS

- b) Consider the following three input variable function:  $f(X_2, X_1, X_0) = X_2'X_1'X_0' + X_2X_1'X_0 + X_2X_1X_0 + X_2'X_1X_0'$ . Determine the minimum form of the function using Karnaugh maps. Implement the function using basic logic gates.

9 MARKS

- c) What is the difference between Moore and Mealy finite state machines? Draw the organization for those two FSM fundamental types.

10 MARKS

### Question 3

- a) What are the main types of memory? Describe the basic memory operation.

6 MARKS

- b) Describe (draw) the basic computer organization, describe the operation and role of each of the subsystems (buses, central processing unit, memory and I/O subsystems).

9 MARKS

- c) Describe hardware interrupts, processing of hardware interrupts and interrupt handlers.

10 MARKS

## Section B (Questions 4 to 6)

#### Question 4

- a) Answer the following questions:
- What is a process? What is a thread?
  - What is the difference between a process and a program?
  - What are the possible states of process? Draw the transition diagram.
- 6 MARKS
- b) Describe the process scheduler organization and operation. Describe the cooperative and preemptive schedulers.
- 9 MARKS
- c) Describe the time slice (Round Robin) process scheduling algorithm. Give a practical example for a number of four processes and a time slice size of 50us. The processes have the following service times:  $\tau(p1) = 474\mu s$ ,  $\tau(p2) = 250\mu s$ ,  $\tau(p3) = 125\mu s$ ,  $\tau(p4) = 75\mu s$ .

10 MARKS

#### Question 5

- a) Describe the memory hierarchy. Describe the cache memory operation.
- 6 MARKS
- b) Consider four processes (A, B, C and D) that are stored on disk and are about to be loaded in the main memory (in the following order: A, B, C and D). Process A has four pages, process B has three pages, process C has five pages and process D has five pages. Assume that the main memory has a size of 16 physical frames (numbered 0 through 15, see Figure 2), all the frames are available and that the operating system will swap out the smallest process to make more room in the main memory.
- Show how the main memory will look after each process is loaded into the main memory.
  - Show the each process page table after the process D has been loaded into the memory.

9 MARKS

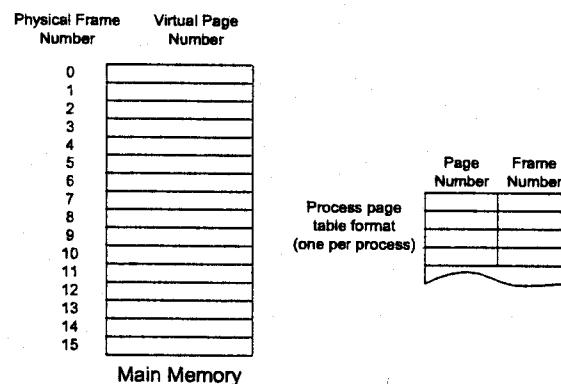


Figure 2: Initial Memory State and Process Page Table Format

- c) In the context of virtual memory, clock replacement algorithm (replacement policy), consider the initial state of the circular buffer the one in the Figure 3 (just prior to a page replacement). Considering that the new page to be brought in the main memory is page 145, show the state of the buffer after the clock replacement algorithm is applied.

10 MARKS

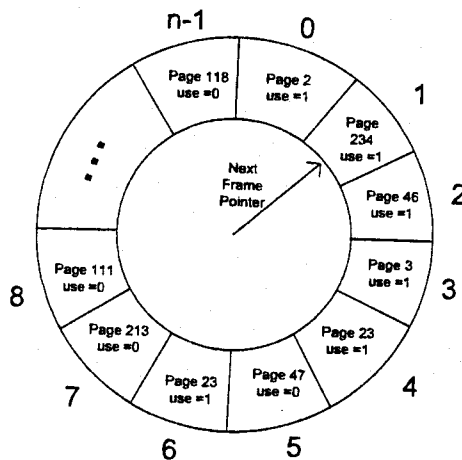


Figure 3: Initial State of the Circular Buffer

### Question 6

- What is a critical section? Give examples of typical critical sections. 6 MARKS
- What are semaphores? What are the typical defined operations upon semaphores? 9 MARKS
- Consider the code in the Figure 4.
  - Explain what would be the console output of the program.
  - How many times and how often (seconds) is the message "MyThread gets access to the critical section" message gets printed?
  - Consider moving the "*sleep(2);*" statement after the statement "*sem\_post(&s);*" in the MyThread function. How would this affect the behaviour and the output of the process?

10 MARKS