

**OLLSCOIL NÁISIÚNTA NA hÉIREANN**  
THE NATIONAL UNIVERSITY OF IRELAND, CORK

**COLÁISTE NA hOLLSCOILE, CORCAIGH**  
UNIVERSITY COLLEGE, CORK

**Summer Examinations 2011**

**CS2503 Operating Systems 1**

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**Total Marks: 80**

**Answer TWO QUESTIONS**

**TIME ALLOWED: 1.5 hours**

**QUESTION 1 (40 Marks)**

- (a) A CPU has an 8-bit data bus and a 16-bit address bus. What are the addresses of the lowest and highest memory locations, expressed in hexadecimal? Give the number of addressable memory locations, expressed in K. **(8 marks)**
- (b) An interrupt system reads an 8-bit interrupt level as part of the interrupt cycle following an INT signal. Entries in the interrupt vector, which begins at address 0, are 4 bytes long. Give the addresses in hexadecimal of (i) the first byte of the vector entry for level 5 and (ii) the first free byte following the interrupt vector. **(10 marks)**
- (c) Bourne shell script **daytest** is called from the command line by **daytest** day, where day is "Mon", "Tue" or "Wed". Test the condition that the entered value of day is "Tue". If it is, print a message "Today is Tuesday". Otherwise, print a message "Not today." The shell is located at /user/bin. Write the script **daytest**. **(10 marks)**
- (d) In a Bourne shell script, the name of a file is entered as the second word following the script name on the command line. Give the statement to add execute permission for the owner of the file. **(6 marks)**
- (e) In a Bourne shell script, the name of a file is entered as the first word following the script name on the command line. Give the statement to count the words in the file and put the output in the positional parameters. **(6 marks)**

**QUESTION 2 (40 Marks)**

- (a) What is a process? In many systems, it is possible for a process to lose control of the CPU and return directly to the READY state. Why might this happen? **6 Marks**
- (b) What is the quickest way to achieve mutual exclusion in a single-CPU system? List two problems associated with it. **6 Marks**
- (c) List and explain the three conditions necessary for a correct solution to the critical section problem. **8 Marks**
- (d) Describe an integer-based solution to the critical section problem that uses three variables as follows: turn: (one, two); p1wantsin, p2wantsin: boolean; **10 Marks**
- (e) Give semaphore-based outline code for a producer and a consumer process in the bounded-buffer producer-consumer problem. You may assume the existence of high-level operations "Produce Item", "Consume Item", "Place Item in Buffer" and "Take Item from Buffer". **10 Marks**

### QUESTION 3 (40 Marks)

The program below is written in Intel 80x86 assembly language. Assume that an opcode plus one register address can be contained in a single byte. Any immediate data requires at least one additional byte, depending on the value of the data. Assume that the offset of a memory address requires 16 bits. Ignore segmentation.

- (a) Describe how a two-pass assembler would process the source code file containing this program, mentioning all tables used and output files produced. **10 Marks**
- (b) Show the addresses generated by the first pass of the assembler, in the form of a table with the addresses in Column 1 and the corresponding contents in Column 2. It is not necessary to translate the contents. **10 Marks**
- (c) List the contents of the relocatable file generated by the assembly process. Comment on each feature introduced by relocatability and pay attention to endian-ness. You must give everything here in numeric form, with the exception of opcodes and register addresses. For example, you can write MOV AX, 1 in exactly this form throughout your answer. **20 Marks**

```

CSEG

MOV  AX, 2
SUB  AX, 1
MOV  ANSWER, AX
HLT

ANSWER  DW  0

END
```