MARCH 2017

HARDWARE & OPERATING SYSTEMS

Instructions to candidates:
a)   Time allowed: Three hours (plus an extra ten minutes' reading time at the start – do not write anything during this time)
b)   Answer any FIVE questions
c)   All questions carry equal marks. Marks for each question are shown in [ ]
d)   Mark allocation should determine the length of your answer and the time you spend on it. Generally, one mark is awarded for each valid point
e)   Ensure that you pay particular attention to words underlined, in CAPITALS or in **bold**. FEW OR NO MARKS will be awarded to any question where these are ignored
f)   Use RTL (Register Transfer Language) to define actions in questions related to Fetch-Execute cycle or assembly language programming
g)   Read all sections of any question before attempting any part of it
h)   No computer equipment, books or notes may be used in this examination

1.   A multiprogramming operating system normally has three levels of scheduler – low-level (or dispatcher), middle-level and high-level.
   a)   Describe the tasks that are performed by EACH of the three schedulers.   [12]
   b)   Describe the data that must be passed to a scheduler to perform its tasks.   [4]
   c)   Outline the general aims of the scheduling process.   [4]

2.   a)   A is a 4-bit register. A circuit is required to produce a 1 output if no more than one of the bits of A are set to 1. A zero is output if two or more are set to 1.
         i   Draw up a truth table to show all the possibilities that can occur and the resulting output.   [5]
         ii   Write a Boolean expression to achieve the required output and simplify it if necessary.   [5]
         iii   Draw a circuit diagram, labelling each component used.   [5]
   b)   Define **Exclusive OR**. Write down a Boolean expression in its simplest form for a 2-input Exclusive OR which uses only AND, OR and NOT components. Draw the circuit diagram for this.   [5]

3.   a)   Distinguish clearly between the following forms of memory:
         i   RAM
         ii   ROM
         iii   PROM
         iv   EPROM
         v   Cache   [2 each]
   b)   Identify the TWO main bus configurations normally found within a PC. Explain why one has a limiting factor which affects the overall performance of the computer.   [6]
   c)   Explain the concept of virtual memory and how it works.   [4]

4.   a)   By using a diagram, show how the various parts of an internal computer system are connected. Your answer must include Memory, Processor, Controllers, Address/Control and Data Bus.   [10]
   b)   Define the function of the BIOS. Include in your answer its purpose and relationship hardware.   [4]
   c)   Describe the term **von Neumann model**.   [6]

5.   For EACH of the following input devices, describe:
   •   what the user needs to do before data capture
   •   any limitations imposed on the data
   •   how the hardware itself reads the data
   a)   Barcode reader (borrowing and returning books in a library)   [5]
   b)   Magnetic stripe reader (ATM cards)   [5]
   c)   Optical mark recognition reader (for marking exam papers)   [5]
   d)   Touch screen (providing tourist information)   [5]

6. a) Define the terms **cluster** and **file allocation table (FAT)**. Describe how a large new file can be stored on a disk for which there is no single area large enough because of many smaller files scattered randomly throughout its capacity. Draw a disk map diagram to illustrate your answer. [6]
   b) A sequential file is being read from a disk and each record processed in turn.
      i   Explain how the speed of access is improved by the technique of BLOCKING.
      ii   Explain the events that occur internally as a series of 400-byte records are written to disk in sequence when the block size is 1K bytes. Diagrams may assist your answer. [8]
   c) The user can sometimes choose the block size. Give ONE advantage and ONE disadvantage of choosing a large block size, explaining your reasons. Explain how the user is able to choose the best size for his or her particular use. [6]

7. Explain the roles played by EACH of the following during the Fetch-Execute cycle. Use Register Transfer Language to describe the action wherever possible. Some elements may be involved in only one of the phases and others in both. Your answer must, therefore, identify in which phase(s) each occurs. No marks are awarded for merely defining them.
   a) Accumulator
   b) ALU
   c) Buses
   d) CIR
   e) Control unit
   f) MAR
   g) MDR
   h) Microcodes
   i) PC
   j) System clock   [2 each]

8. a) Distinguish between <u>hardware</u> and <u>software</u> interrupts. Briefly describe the process involved with EACH type of interrupt. [8]
   b) Explain the function of ROM and other non-volatile forms of memory. [6]
   c) Describe the operation of RAM, you may include architecture, types and virtual memory in your answer. [6]