General Comments

Once again examination technique was poor for a significant number of candidates. It is important to read the question carefully, understand what the examiners are asking for and then answer the question given - not the question you would like to have been asked. The question paper carries 120 marks and there are 120 minutes in which to answer the questions. That is, one mark per minute; spending 30 minutes on a question that carries 12 marks is not sensible.

QUESTION ONE

A computer's architecture (now commonly called the ISA or *instruction set architecture*) is made up of a computer's register set, instruction set, and addressing modes.

Describe the essential features of the instruction set architecture of any processor with which you are familiar (you may choose to describe a hypothetical processor). You are not expected to describe the entire instruction set, but you should give examples of the major instruction types (for example, arithmetic instruction, program flow control instructions, etc.). **(30 Marks)**

Most candidates failed to understand the requirements for this question; namely, a discussion of the *instruction set architecture* as defined in the first sentence of the question. Consequently, the answers offered focussed on discussing different types of instructions rather than the register set, instruction set and addressing modes.

Answer Pointers:

Description of different registers (and other related components, e.g. ALU)
A diagrammatic presentation showing interconnection of different registers;
Instruction format;
Examples of different instruction types including addressing modes.

QUESTION TWO

The operating system is often called "*the point at which hardware and software meet*". This statement is particularly true when it is applied to *memory management.*

a) **What is the purpose of memory management (and vital memory)?** **(15 Marks)**

b) **How is the memory management implemented in a typical microprocessor system** **(15 Marks)**

A significant proportion of candidates was not able to differentiate between memory - organisation - dealing with how internal and external memory devices are arranged and memory management - dealing with how memory is shared between different programs.

Answer Pointers:

Purpose of memory management - sharing memory between different programs; sharing common programs in memory between different users; dynamic mapping of logical memory references into physical memory addresses; protection of memory space against unauthorised access.
Implementation of memory management - swapping, segmentation, paging and virtual memory.

A description of the above points plus some brief comments on why they've developed was looked for.

QUESTION THREE

Early personal computers were invariably stand-alone devices. Today's personal computers are often interconnected, either by means of local area networks or via the internet.

a) **Explain how a PC can be connected to the internet via the public switched telephone network using a modem. Describe the way in which a modem works and the facilities it offers. Give the characteristics of a modern modem.**
(15 Marks)

b) **Data transmission is inherently error prone (particularly over the public switched telephone system). Briefly describe how a computer's hardware and software is able to reliably transmit information across such a network.**
(8 Marks)

c) **Not very long ago, the telephone modem that connects a computer to the internet via the telephone system offered the domestic computer user the only practical means of communicating with the internet. Commercial and business users were, of course, able to employ very expensive leashed lines or connect directly to very high-speed networks.**

In recent years, domestic computer users have been able to connect to the internet at higher speeds than those provided by traditional telephone modems. Describe some of the techniques that give good domestic computer users a higher-speed access to the internet. (7 Marks)

a) Section a) asked for three pieces of information; a point not picked up by some candidates. Many candidates described how a PC could be connected to the Internet but ignored the other two parts.
b) Not many candidates were aware of any error handling techniques.
c) Candidates who attempted this part had good general knowledge of the correct techniques.

Answer Pointers

a) Two issues needed to be considered: tools for connecting to the Internet - a telephone, ISP account, TCP/IP software; tools for surfing - web browser, e-mailer, ftp, etc.

b) A Modulator/Demodulator - device that can encode digital signals from a computer into analogue signals that can be transmitted over analogue lines, and vice versa.
c) Characteristics of modern modems - V.90 operate at 56Kbps.
d) Software and hardware for error correction, most commonly known being Forward Error Correction (FEC), parity, Hamming codes, CRC.
e) Broadband, ISDN, ASDL, Cable modem.

Question 4

All computers have to provide an input/output mechanism that information from the external world to be read into the computer to be sent to the external world.

a) **There are three basic strategies for dealing with I/O transactions: polled or program-driven I/O, interrupt-driven I/O, and direct memory access (DMA).**

   Briefly describe how each of these I/O mechanisms operates and compare and contrast each of these three mechanisms in terms of their efficiency and cost of implementation. **(15 Marks)**

b) **I/O transactions may take place in one of two ways: *synchronously* or *asynchronously*. These modes are also called *open-loop* and *closed-loop*, respectively. With the aid of timing diagrams, compare and contrast these two ways of controlling the flow of information in to or out of a computer.** **(10 Marks)**

c) **The two most important parameters of an I/O system are *bandwidth* and its *latency*. Define the meaning of these two terms and explain their significance in evaluating the performance of an I/O system.** **(5 Marks)**

a) Many candidates who attempted this part had knowledge of the different techniques.
b) Many candidates could not tell the difference or confused the two transmission methods.
c) Many candidates knew what bandwidth is and its significance but not latency.

Answer Pointers:

a) Programmed I/O - CPU checks I/O devices in turn, issues I/O command and waits for operation to be completed before proceeding. Interrupt I/O - CPU issues I/O command proceeds with other tasks and is interrupted by I/O device when ready. DMA - CPU sends request for transfer of block of data, continues with other tasks and is interrupted after entire block is transferred.
b) Asynchronous transfer - requires control signals to indicate when data is available. Synchronous transfer - communicating devices transmit data at a rate determined by clock pulses
c) Bandwidth - maximum rate at which data can be transmitted over a communication channel. Latency - time to access a source of data.

QUESTION FIVE

a) Name any two *input* devices and any *output* devices on a computer system.
                                                                                (4 Marks)

b) State the purpose of the *data bus, address bus,* and *control bus.*
                                                                                (6 Marks)

c) A computer address bus comprises of 20 lines. What is the maximum amount of *addressable memory?*

a) Most candidates could name at least two input and two output devices
b) Many candidates could clearly state the purposes of the different buses, although a significant proportion gave vague answers, such as, "used for data/address/control signals".
c) Many could not work out what the maximum addressable memory is (or refers to).

Answer Pointers:

a) Input - keyboard, mouse; Output - VDU, printer.
b) Data bus - part of system bus used to transfer data; Address bus - part of system bus to carry address (reference) to a memory location (or I/O device); Control bus - part of system bus used for transfer of control signals.
c) 2^{20}

QUESTION SIX

Briefly describe the function of the following digital devices:

a) **Shift register**   (4 Marks)
b) **Half adder**   (4 Marks)
c) **Counter**   (4 Marks)

A basic lack of knowledge was displayed and many candidates could not satisfactory describe the operation or purpose of these devices.

Answer Pointers:

Shift register - a device which transfers (shifts) its bit pattern to the left or right on each clock pulse; Half-adder - single-bit adder which produces a sum and carry output; Counter - a register whose value is incremented by 1 on each clock pulse.

QUESTION SEVEN

A 2-input multiplexer is a circuit which steers one of the inputs to the single output, depending on the value on a third (control) input.

a) **Write the truth table for the multiplexer.**   (4 Marks)
b) **Derive a simplified function for the multiplexer.**   (4 Marks)

c) Draw the circuit implementation using AND, OR and NOT Gates. (4 Marks)

Not many candidates attempted this question, but of those who did the majority got a high mark.

Answer Pointers:

The answer could be inferred from common sense. There are three inputs, say A, B, and C, where C is the control input. The output will be A, say, if C if "0" and B if C is "1". Hence, the output function would be AC' + BC.

QUESTION EIGHT

a) **Convert the 7-bit binary unsigned number 1011101 to its decimal equivalent**
   (4 Marks)
b) **Convert the negative decimal number-113 to its 2s-compliment binary equivalent.   (4 Marks)**
c) **Give the sum of the above two numbers as a 2s-compliment binary number.**
   (4 Marks)

This is straightforward binary arithmetic, which most candidates attempted and got high marks.

QUESTION NINE

a) **Define what is meant by the *addressing mode* of a microprocessor.**
   (4 Marks)
b) **Describe each of the addressing modes: *immediate, indirect, index, register indirect.*   (4 Marks)**

It was apparent that many candidates who attempted this question had an idea what an addressing mode is, but could not describe the concept. Many candidates also confused the different types of addressing, while others described types of addressing not asked for in the question.

Answer Pointers

a) Addressing mode - means of reference to locations in main memory.
b) Immediate - the actual address (operand) is present in the instruction;
    Indirect - the address (operand) field of an instruction refers to a memory location which in turn contains a memory location where the operand is held.
    Index - displacement addressing in which the address field of the instruction contains a memory address and a reference contains a positive displacement from that memory location.
    Register indirect - the address field refers to a register which in turn contain the address of a memory location where the data is contained.

QUESTION TEN

a) **Describe and give illustrations of *bus, ring* and *star* network topologies.**
   (6 Marks)
b) **Give one advantage and one disadvantage of each of the above topologies.**
   (6 Marks)

Most candidates attempted this question and were able to answer the first part satisfactorily. Part b) seemed to present problems to many candidates in deciding the advantages and disadvantages.

Answer Pointers:

Bus: (advantage) - easy expansion, cheaper implementation, breakdown of one node does not disrupt network; (disadvantage) - access conflict, slow, limited distance.
Star: (advantage) - easy expansion, breakdown of one node does not disrupt network; (disadvantage) - expensive, breakdown of central node disrupts entire network;
Ring: (advantage) - easy expansion, cheaper implementation, faster; (disadvantage) - breakdown of one node disrupts entire network (can be overcome by FDDI).

QUESTION ELEVEN

a) **Differentiate between an *analogue* signal and a *digital* signal. Give examples.**
(4 Marks)
b) **Define, and give an example of each of the following: *primary memory*, *secondary memory*, and *cache memory*, for each type of memory, state whether the memory is *volatile* or *non-volatile.***
(8 Marks)

Most candidates attempted and, generally, had good knowledge of the concepts involved. A general comment is that, a number of candidates seemed to confuse volatile (information lost when power off) and non-volatile. A few candidates also confused between primary memory (directly accessible) and secondary memory (backup storage).

QUESTION TWELVE

Briefly describe the following internet-related terms and their significance.

a) **Domain Name Server (DNS)**   **(3 Marks)**
b) **Uniform Resource Locator (URL)**   **(3 Marks)**
c) **IP Address**   **(3 Marks)**
d) **Gateway**   **(3 Marks)**

Most candidates who attempted this question had an idea about two or more of the terms.

Answer Pointers:
DNS - a distributed Internet directory service. DNS is used mostly to translate between domain names and IP addresses
URL - the global address of documents and other resources on the WWW
IP address - an identifier for a computer or other device on a network.
Gateway - a combination of hardware and software that links two different types of networks