**Topic: Use of the hexadecimal system**

Reading Time: 20 mins

**·        Note\* Highlight important/core points while reading**

·        Read the content and write the answers given in the document in your words, to get the solid grip on topic.

**Use of the Hexadecimal System in Computing**

The **hexadecimal (base-16) system** is widely used in computing because it simplifies **binary representation** while being easier for humans to read. Since each **hex digit represents 4 binary digits (bits)**, it provides a **shorter and more manageable** way to work with large binary numbers.

For example:

* Binary: **110101110011**
* Hexadecimal: **D73** (much shorter and easier to read)

**Uses of the Hexadecimal System**

**1. Error Codes**

Hexadecimal is used in **error messages** and **debugging codes** generated by computers and software.

* When a program crashes or encounters an issue, it often displays an **error code** in hexadecimal.
* Example: **0xC0000005** (indicating a memory access violation).
* Programmers use these codes to diagnose and fix software problems.

**2. MAC Addresses**

A **MAC (Media Access Control) address** is a unique identifier assigned to network devices such as computers, routers, and smartphones.

* It consists of **12 hexadecimal digits** (48 bits), usually written in groups of two separated by colons (:) or hyphens (-).
* Example:
  + **00:1A:2B:3C:4D:5E**
  + **A1-B2-C3-D4-E5-F6**
* The MAC address ensures that each device has a unique identity in a network.

**3. IPv6 Addresses**

The **IPv6 (Internet Protocol version 6) address** system uses hexadecimal to represent IP addresses, which are used to identify devices on the internet.

* IPv6 was introduced to replace IPv4 because IPv4 addresses (e.g., **192.168.1.1**) were running out.
* IPv6 addresses are **128-bit long** and are written as **eight groups** of four hexadecimal digits separated by colons (:).

Example of an **IPv6 address:**

2001:0db8:85a3:0000:0000:8a2e:0370:7334

* The use of hexadecimal makes IPv6 addresses shorter and easier to read compared to their long binary representation.

**4. HTML Colour Codes**

Hexadecimal is used to represent colours in **HTML (HyperText Markup Language)** for web design.

* Colours are represented using a **six-digit hexadecimal code** (two digits each for Red, Green, and Blue - RGB).
* Example:
  + **#FF0000** → Red
  + **#00FF00** → Green
  + **#0000FF** → Blue
  + **#FFFFFF** → White
  + **#000000** → Black
* Web designers use these codes to specify exact colours for text, backgrounds, and other design elements.

**A-Rated Questions/Answers By Examiner**

**Q1: Why is hexadecimal used instead of binary in computing?**

**Answer:** Hexadecimal is used because it is **shorter and easier to read** than binary while still being directly convertible. Each **hex digit represents 4 binary digits**, making it a more compact way to handle large binary numbers.

**Q2: How many bits are used in a MAC address? Write an example of a MAC address.**

**Answer:** A MAC address is **48 bits (6 bytes) long** and is written in **hexadecimal format**.  
Example: **00:1F:5B:A7:3D:8C**

**Q3: Convert the hexadecimal number 2F to decimal.**

**Answer:**

* 2F₁₆ = (2 × 16¹) + (15 × 16⁰)
* = (2 × 16) + (15 × 1)
* = 32 + 15 = 47₁₀

**Q4: What is the hexadecimal representation of the colour red in HTML?**

**Answer:** The hexadecimal representation of the colour red in HTML is **#FF0000**.

**Q5: Write an example of an IPv6 address and explain why IPv6 uses hexadecimal.**

**Answer:** Example of an IPv6 address:

2001:0db8:85a3:0000:0000:8a2e:0370:7334

IPv6 uses hexadecimal because it makes **long binary addresses shorter and easier to read** while still representing **large numbers efficiently**.

### Write your Answers on your Notebook and Verify it on Next Screen

**Q6: Convert the binary number 11110110 to hexadecimal.**

**Q7: What are two advantages of using hexadecimal for MAC addresses?**

**Q8: Convert the hexadecimal number 7B to decimal.**

**Q9: Why are HTML color codes written in hexadecimal instead of decimal?**

**Q10: Convert the IPv6 address 2001:0db8:85a3:0000:0000:8a2e:0370:7334 to binary (first two blocks).**

**Answer:**

* Split into **4-bit groups** from right to left: **1111 0110**
* Convert each group:
  + **1111₂ = F₁₆**
  + **0110₂ = 6₁₆**
* **Final Answer:** **F6₁₆**

**Answer:**

1. **Shorter representation**: A 48-bit MAC address is easier to read and write in **hexadecimal** compared to **binary**.
2. **Easy conversion**: Hexadecimal **maps directly to binary** (4 bits per hex digit), making it useful in networking applications.

**A:**

* **7B₁₆ = (7 × 16¹) + (B × 16⁰)**
* B in hexadecimal = **11 in decimal**
* **Calculation:**

(7 × 16) + (11 × 1) = 112 + 11 = 123₁₀

* **Final Answer:** **123 in decimal**

**Answer:**

* Hexadecimal provides a **compact and structured way** to represent RGB values.
* Each **color channel (Red, Green, Blue)** gets **two hexadecimal digits**, making it easier to read and edit than long decimal values.
* Example: **#FF5733** (Red = FF, Green = 57, Blue = 33).

**Answer:**

* Convert **2001₁₆** and **0db8₁₆** to binary:
  + **2001₁₆ = 0010 0000 0000 0001₂**
  + **0DB8₁₆ = 0000 1101 1011 1000₂**
* **Final Answer (First Two Blocks in Binary):**  
  2001₁₆ = 0010 0000 0000 0001₂  
  0DB8₁₆ = 0000 1101 1011 1000₂