

Regular/Scholarship/Back Exam - 2082 Shrawan/Bhadra (Regular/Back)

Program: Diploma in Information Technology/ Computer Engineering

1 (a) Define data streams in multimedia. Explain the components of a multimedia system

A data stream in multimedia refers to a continuous flow of digital data that represents audio, video, text, graphics or other media elements.

Explain the components of a multimedia system.

A multimedia system is a computer-based system that captures, creates, stores, processes and presents multiple forms of media in an integrated manner. The major components are:

Media type	Definition	example
Text	Text is written language used to communicate information, such as words, labels, instructions, and paragraphs	A news article, a book page, subtitles in a movie
Audio	Audio is media that communicates through sound, such as speech, music, narration, or sound effects.	A podcast, a song, a radio broadcast
Video	Video is media that uses moving images, usually with sound, to show actions, events, or stories.	A YouTube tutorial, a movie, a recorded class lecture
Animation	Animation is the process or art of making drawings, objects, or images appear to move.	A cartoon, an animated explainer, motion graphics in an ad
Graphics	Graphics are static visual elements such as pictures, diagrams, illustrations, icons, or charts used to explain or support ideas.	A logo, a bar chart, an infographic, a photograph

2 Explain the concept of sound. Explain how speech is analysed and transmitted.

Sound is a form of energy that travels through a medium (air, water or solid) as a mechanical wave produced by vibrating objects. When an object vibrates, it creates variations in air pressure that propagate outward and are sensed by the ear (or a microphone).

In multimedia, sound exists in two forms:

- Analogue sound – continuous waveform from real-world sources.
- Digital sound – sampled and quantised values stored as binary data (e.g. WAV, MP3, AAC)

Explain how speech is analysed and transmitted. [8 Marks]

Speech is the human voice used to convey meaning. In multimedia systems, speech is processed so that it can be stored, transmitted, recognised or replayed. The analysis and transmission process consists of the following steps:

A. Speech Production and Analysis

- Source: lungs push air through the vocal tract; vocal cords produce voiced (periodic) or unvoiced (noise-like) sounds.
- Conversion: microphone converts acoustic pressure variations into an electrical (analogue) signal.
- Sampling: the analogue signal is sampled at a fixed rate, e.g. 8 kHz for telephony or 44.1 kHz for CD-quality audio (Nyquist rule: sampling rate $\geq 2 \times$ highest frequency).
- Quantisation: each sample is rounded to a discrete digital value (8-bit or 16-bit).
- Encoding: digital samples are encoded into a binary stream.

B. Transmission of Speech

- The encoded digital speech is packetised and sent over a communication channel (wired, wireless or IP network).
- Transmission techniques:
 - *Analogue transmission – speech sent as continuous waveform (AM/FM modulation).*
 - *Digital transmission – PCM, ADPCM, DPCM encoded bitstreams.*
- Key issues during transmission:
- Bandwidth requirement (depends on sampling rate and bits per sample).

3. What is image analysis? Describe image analysis techniques

Image analysis is the process of examining, interpreting and extracting meaningful information from a digital image. It involves studying the pixel data, identifying patterns, regions and objects, and converting raw image information into a description or decision useful for human or machine use.

.Describe image analysis techniques.

The major image analysis techniques used in multimedia are:

1. Image Acquisition and Pre-processing

- Capturing the image using camera, scanner or sensor.
- Pre-processing includes noise removal, contrast enhancement, geometric correction and colour normalisation.

2. Image Segmentation

- Partitioning the image into meaningful regions or objects.
- Thresholding – pixels above/below a grey-level are separated.

3. Feature Extraction

- Texture – statistical measures (contrast, homogeneity, entropy, GLCM features).
- Shape – area, perimeter, compactness, moments, Fourier descriptors.

4. Image Representation and Description

- Boundary representation – chain codes, polygons, splines.
- Regional representation – moments, texture descriptors, skeleton.

5. Object Recognition and Classification

- Statistical methods – Bayes classifier, nearest-neighbour.
- Neural networks and deep learning – CNNs for image classification.

4. What do you mean by computer-based animation? Explain. Discuss animation languages?

Computer-based animation is the technique of generating moving images (sequences of frames) with the help of a computer. It uses mathematical models, graphics hardware and specialised software to simulate motion, transform objects and produce visually convincing sequences for entertainment, education, simulation and advertising.

Types of Computer Animation:

1. 2-D Animation (Vector-based or bitmap-based)

- Sprites move on 2-D coordinates.
- Tools: Adobe Animate, Toon Boom, Synfig.

2. 3-D Animation

- Models have depth and are rendered with realistic light and shadow.

- Tools: Autodesk Maya, 3ds Max, Blender, Cinema 4D.
3. Morphing – smoothly transforming one shape into another.
 4. Skeletal / Character animation – using bones, inverse kinematics for realistic character motion.
 5. Motion-capture animation – recording real human motion and applying it to a 3-D model.
 6. Physics-based animation – mass, gravity, collision, fluid simulation.

Techniques used in computer animation:

- Key-frame animation – artist defines important positions; computer generates in-betweens.
- Tweening / in-betweening – automatic interpolation between key frames.
- Path animation – object follows a defined trajectory.
- Procedural animation – motion generated automatically from rules / algorithms.
- Scripted / parametric animation – driven by a programming language or script.

Discuss animation languages.

Animation languages are specialised programming or scripting languages used to describe, control and automate the motion, behaviour and rendering of objects in computer animation.

- They provide commands for object placement, motion paths, timing, camera control, lighting and interaction.
- Many are interpreted, allowing the animator to preview changes immediately.

Examples of animation languages and systems:

- Lingo – scripting language of Macromedia Director for multimedia and animation authoring.
- ActionScript – scripting of Adobe Flash / Animate SWF movies.

5 . Write five needs/importance of multimedia compression. Differentiate between lossy and lossless compression.

- 1. Reduces storage requirement — uncompressed audio, image and especially video files are very large (e.g. one second of uncompressed SD video $\approx$ 30 MB), so compression is essential to fit content on disk, CD, DVD or memory card.
- 2. Saves transmission bandwidth — smaller files mean multimedia can be transmitted faster over networks and the Internet (streaming, video conferencing, online learning).
- 3. Enables real-time delivery — compression reduces the bit-rate so audio/video can be played back while being downloaded.
- 4. Lowers cost of distribution and storage — fewer CDs, DVDs, hard disks and lower network bandwidth bills.
- 5. Improves accessibility — users with limited bandwidth (rural / mobile users) can still access multimedia content because compressed files travel and download quickly.

Differentiate between lossy and lossless compression.

Basis	Lossy Compression	Lossless Compression
Definition	Permanently discards some less-important data to achieve high compression.	Reconstructs the exact original data after decompression — no information is lost.
Data after decompression	Not identical to the original; some quality is sacrificed.	Identical / bit-for-bit same as the original.
Compression ratio	Very high (10:1 to 100:1 or more for video).	Lower (typically 2:1 to 4:1).
Visual / audio quality	May produce visible artefacts (blocking, blurring) if compression is too aggressive.	Quality is preserved perfectly.
Examples of techniques / formats	JPEG (images), MP3 (audio), MPEG-1/2/4 (video), AAC, DivX.	Run-Length Encoding, Huffman coding, LZW (GIF, PNG), FLAC (audio), ZIP.
Typical use	Images, audio and video for end-user consumption where small file size matters more than perfect fidelity.	Text, executable files, source code, medical or scientific images where any data loss is unacceptable.
Trade-off	Smaller files at the cost of quality.	Perfect quality at the cost of file size.

6. Explain the development phases / historical evolution of multimedia in brief.

Multimedia has developed through several distinct phases as computing power, storage and networking technology have improved:

Phase 1 – Text-Only Era (1960s–1970s)

- Computers handled only text and numbers.
- Output was through printers and text terminals.

Phase 2 – Addition of Graphics (1980s)

- Introduction of bit-mapped graphics, simple icons and the Apple Macintosh GUI (1984).
- Improved display hardware allowed pictures to be shown on screen.

Phase 3 – Integration of Audio and Video (early–mid 1990s)

- CD-ROM drives became affordable (hundreds of MB of storage).
- MPEG-1 standard (1993) enabled full-motion video on a CD.

Phase 4 – Internet and Streaming (late 1990s–2000s)

- WWW and broadband Internet caused multimedia to move online.
- RealNetworks RealPlayer (1995), Windows Media Player, QuickTime.

Phase 5 – Mobile and Social Multimedia (2007 onwards)

- Smartphones (iPhone in 2007) and 3G/4G/5G networks made multimedia truly portable.
- Cloud storage and cloud streaming (Spotify, Netflix) — content delivered from the cloud.

Phase 6 – AI-Driven and Immersive Multimedia (2020s onwards)

- AI-generated images, audio and video (deep-learning models).
- Real-time language translation, voice synthesis, deepfake technology.

7. 7. Explain quality of service and database management system in multimedia. [5+5]

Quality of Service (QoS) refers to the set of techniques and mechanisms used by a network or system to guarantee a certain level of performance for multimedia data transmission and playback.

Main QoS parameters for multimedia:

- Throughput / Bandwidth – required data rate (e.g. 64 kbps for voice, 1–5 Mbps for SD video, 5–25 Mbps for HD video).
- End-to-end Delay (Latency) – time from sender to receiver; for real-time voice/video this must be below ~150 ms to feel natural.
- Jitter – variation in delay between consecutive packets; must be smoothed by a playout buffer.

Explain Database Management System (DBMS) in multimedia.

A Database Management System (DBMS) in multimedia is a software system designed to store, retrieve, manage and query multimedia data such as images, audio clips, video, animations and their associated descriptive (metadata) information.

Components of a multimedia DBMS:

- Multimedia data – the actual media files (image, audio, video).
- Metadata – descriptive information about each media item.
- Feature data – extracted characteristics (colour histogram, MFCC, key-points)..

Types of multimedia databases:

- Object-oriented DBMS – objects with media attributes and methods.
- Relational DBMS with BLOB fields – standard RDBMS extended for binary objects.
- NoSQL / document databases
- Specialised multimedia databases –

8. Discuss models for multimedia synchronisation.

Multimedia synchronisation means keeping multiple media streams (audio, video, text, animation) in proper time relationship so that they play back coherently.

1. Classification of Synchronisation

- Intra-media synchronisation – keeping temporal relationships WITHIN a single stream (e.g. consecutive video frames, audio samples).

2. Steinmetz / Reference Model (Temporal-only)

- Defines the maximum tolerable jitter (ΔT) based on human perception limits.

3. Little / Ghafoor Model (Object-based Petri-Net)

- Models synchronisation with Object Composition Petri Nets (OCPN).
- Each multimedia object is an OCPN node with start (S_i) and end (E_i) ties.

4. Hierarchical Synchronisation Model

- Script level – specification of the overall scenario (author time).

5. Interval-based Model

- Each media unit is described by an interval [S, E] on the presentation timeline.

6. SMIL Synchronisation Model

- Uses begin, end, dur and repeat attributes to control timing of media elements.

Question 9 – Short Notes (Any TWO)

(a) Tips for Creating Good User Interfaces [5 Marks]

A user interface (UI) is the part of a multimedia system through which the user interacts with the application. A good UI is essential for the success of any multimedia product.

Useful tips / guidelines:

- 1. Know your users – design for the skills, age and goals of the target audience. Use personas and user-testing.
- 2. Keep the interface simple and consistent – use familiar widgets, uniform colour scheme and consistent layout across screens.
- 3. Provide clear navigation – menus, bread-crums, back / next buttons, search; the user should never feel lost.
- 4. Use multimedia selectively – graphics, sound and animation enhance content but excessive motion distracts the user.
- 5. Provide feedback – status bars, progress indicators, audio cues; tell the user what is happening.

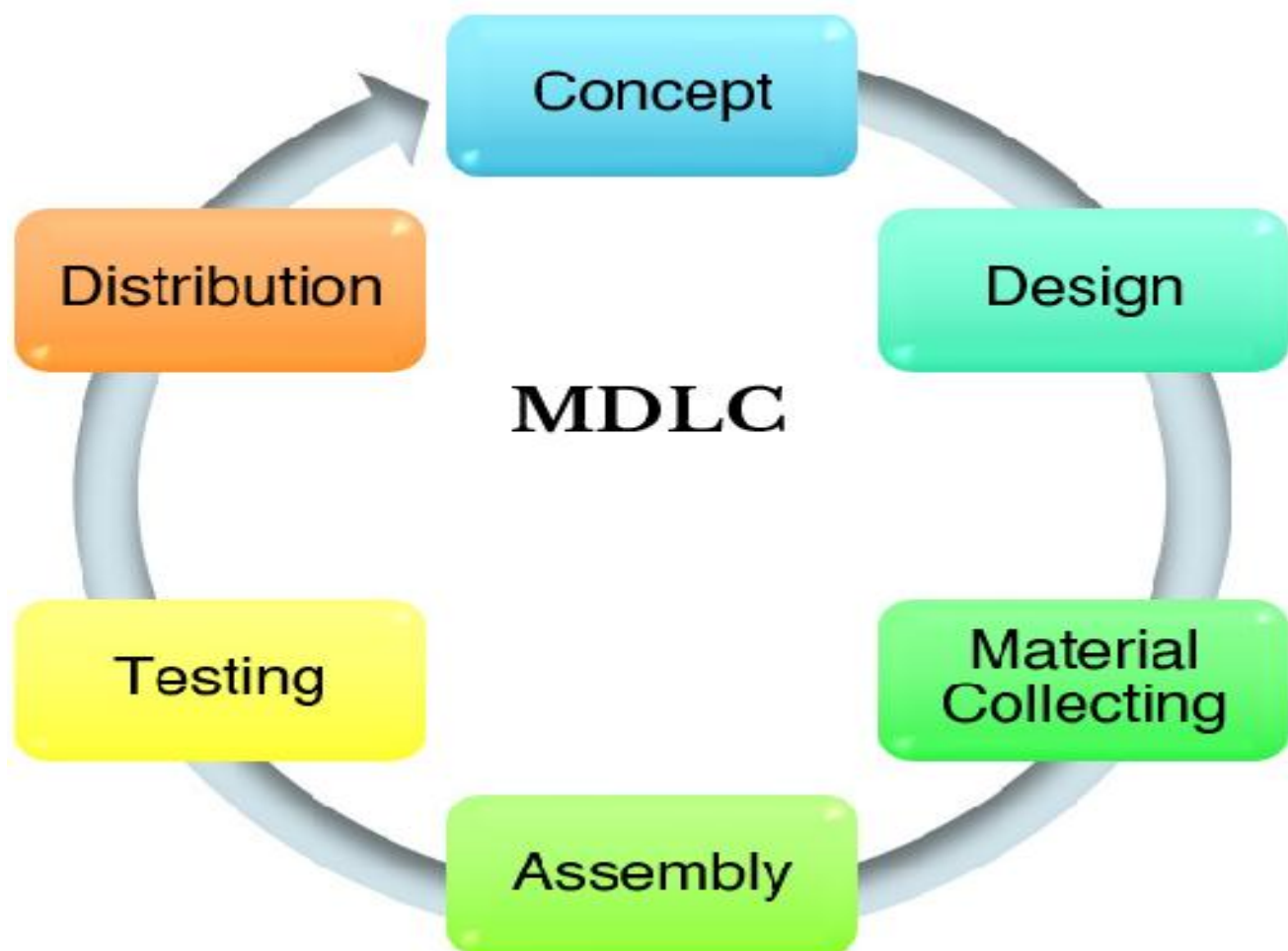
(c) Trends in Multimedia Applications [5 Marks]

Multimedia is evolving rapidly. The major trends shaping the future of multimedia applications are:

- 1. Streaming and on-demand video – services such as Netflix, YouTube, Disney+ dominate entertainment; live streaming and short-form video (TikTok, Reels) are growing.
- 2. Augmented Reality (AR) and Virtual Reality (VR) – immersive media for gaming, training, healthcare, retail and tourism; XR devices improve every year.
- 3. Artificial Intelligence (AI) integration – content recommendation, automatic captioning, speech synthesis, AI-generated images and video.
- 4. Cloud-based multimedia – content stored and processed in the cloud; collaboration tools (Google Docs, Figma, Adobe Creative Cloud).

10. Explain the multimedia system development cycle in brief.

The multimedia system development cycle (also called the multimedia project life cycle) is the structured set of phases followed to plan, design, build, test and deliver a multimedia application. Following a defined cycle improves quality, reduces cost and makes the project predictable.



Phase 1 – Requirement Analysis and Planning

- Define purpose of the multimedia application, target audience and learning / entertainment objectives.

Phase 2 – Design

- Storyboard creation – scenes / screens drawn on paper showing layout, navigation and media placement..

Phase 3 – Content Acquisition / Production

- Collect or create raw media: text, drawings, photos, audio recordings, video clips, 3-D models.

Phase 4 – Implementation / Authoring

- Use authoring tools (Director, Flash / Animate, Adobe Captivate, Articulate) to assemble media into the application..

Phase 5 – Testing

- Functional testing – every button, link and animation behaves correctly.

Phase 6 – Deployment / Distribution

- Package the application for delivery: CD/DVD, web download, app store, cloud-hosted.

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Q1. What are the applications of multimedia? Explain multimedia components.

Applications of Multimedia.

- Entertainment: Video games, movies, music, animation, and streaming platforms.
- Business and advertising: Product presentations, digital marketing, video advertisements, and e-commerce catalogues.
- Medicine and healthcare: Medical imaging (MRI, CT-scan visualization), telemedicine, and training simulations for surgery.
- Engineering and science: CAD/CAM design visualisation, scientific data visualisation, and simulation of physical processes.
- **Multimedia Components**

Multimedia is built from a combination of different media elements integrated together. The major components are:

- 1. Text: The most basic component, used to convey information, labels, and instructions; can be plain, formatted, or hypertext (linking to other content).
- 2. Graphics/Images: Static visual elements such as photographs, drawings, icons and diagrams, represented as either bitmap (raster) or vector graphics, used to illustrate concepts and enhance visual appeal.
- 3. Audio: Sound elements including speech, music, and sound effects, which add realism and can convey information that text/images cannot (e.g., narration).
- 4. Video: A sequence of moving images (with accompanying audio) that presents dynamic, real-world or recorded content, offering the highest level of realism among media types.
- 5. Animation: Computer-generated sequences that create the illusion of movement, used to demonstrate processes, simulate motion, or add visual interest without recording real footage.

Q2. What are the steps of audio digitization? Describe methods of controlling animations.

Steps of Audio Digitization

Audio digitization converts analog sound waves into digital data through three short steps:

1. **Sampling:** Measuring the sound wave at regular intervals. The rate must be at least twice the highest frequency to prevent distortion.
2. **Quantization:** Rounding each measured level to the nearest fixed value. This depends on bit depth and causes minor noise.
3. **Encoding:** Converting those final values into binary code (like PCM) to save as a file (like WAV).

Methods of Controlling Animation

- **Key-frame:** Animator sets main poses; software fills in the gaps (tweening).
- **Procedural:** Math rules and algorithms generate movement automatically (e.g., water, crowds).
- **Physics-based:** Software uses physical laws (gravity, friction) to create realistic motion.
- **Motion Capture:** Records real human movements and maps them onto digital characters.
- **Path-based:** Objects automatically move along a pre-defined line or track over time.

Q3. What is a digital image? Explain how image synthesis and image analysis is performed.

A digital image is a two-dimensional representation of a picture in digital form, composed of a finite number of discrete picture elements called pixels, each having a specific location (coordinates) and an intensity/colour value.

Image Synthesis

Image synthesis is the process of artificially generating a digital image from a description, model, or set of data, rather than capturing it from the real world. It is essentially the reverse of image analysis. Key steps involved are:

- **Modelling:** Defining the geometry/shape of objects to be represented (using 2D/3D models, mathematical curves, or procedural descriptions).
- **Scene composition:** Placing objects, light sources, and a virtual camera/viewpoint within a scene.
- **Rendering:** Converting the 3D scene description into a 2D image by calculating how light interacts with surfaces — including techniques like ray tracing, rasterization, and radiosity.

#Image Analysis

Image analysis is the reverse process — extracting meaningful information from an existing digital image. Its main steps are:

- Pre-processing: Enhancing image quality and reducing noise using filtering, contrast adjustment, and normalization.
- Segmentation: Dividing the image into meaningful regions or objects using thresholding, edge detection, or region-growing techniques.
- Feature extraction: Deriving descriptive attributes such as colour, texture, shape and edges from the segmented regions.

Q4. Write the needs for data compression. Explain about LZW compression.

Need for Data Compression

1. Reduced storage requirement: Compression reduces the size of files, allowing more data to be stored in limited storage space.
2. Faster and more efficient transmission: Smaller compressed files require less bandwidth and time to transmit over networks.
3. Cost savings: Less storage and bandwidth usage translates directly into lower infrastructure and operational costs.
4. Support for real-time multimedia applications: Compression enables real-time streaming and communication (e.g., video calls) within available bandwidth constraints.

LZW (Lempel–Ziv–Welch) Compression

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LZW is a lossless, dictionary-based data compression algorithm that builds a dictionary (table) of recurring patterns/strings found in the input data as it processes it, and replaces repeated sequences with shorter codes referring to dictionary entries. It is used in formats such as GIF and TIFF, and in the UNIX 'compress' utility.

Working principle of LZW encoding:

- Initialize the dictionary with all possible single-character symbols of the input alphabet (e.g., 256 entries for ASCII), each assigned a unique code.
- Read the input data character by character, building the longest string (W) that already exists in the dictionary.
- When the next character (K) is read such that W+K is not in the dictionary, output the code for W, then add the new string W+K to the dictionary as a new entry.
- Set W to the single character K and repeat the process until all input data has been processed.

Q5. What is user interface and why is it important? Explain the phases of multimedia project development

A user interface (UI) is the point of interaction between a human user and a computer system or multimedia application — comprising the visual layout (screens, menus, icons, buttons) and the input/output mechanisms (mouse, keyboard, touch, voice) through which the user controls and receives feedback from the system.

User interface is important because:

- It directly determines usability — how easily and efficiently users can accomplish their tasks.
- A good UI reduces learning time and user errors by making functions intuitive and predictable.
- It affects user satisfaction and engagement, which is critical for the success and adoption of a multimedia application.
- It provides accessibility, allowing users with different abilities and technical skill levels to use the system effectively.
- It builds user trust and confidence through clear feedback, consistency, and error handling.

Explain the phases of multimedia project development.

Planning and Costing: Defining the project's objective, target audience, scope, budget, timeline and resource requirements, and preparing a project proposal.

❑ **Planning & Costing:** Outlining objectives, target audience, budget, timeline, and drafting the proposal.

❑ **Design:** Mapping storyboards, navigation charts, layouts, and user interactions.

❑ **Content Collection:** Gathering and creating necessary assets like text, graphics, and video.

❑ **Production/Assembly:** Integrating all assets into a single interactive layout using authoring software.

❑ **Testing:** Checking links, playback, speed, and bugs across multiple devices.

❑ **Delivery:** Compiling, compressing, and distributing the final app to platforms.

❑ **Evaluation & Maintenance:** Processing post-launch user reviews to patch bugs and update software. These phases are iterative — feedback obtained during testing or after delivery frequently leads back to earlier design or content-collection stages for revision before the final product is finalized.

Q6. Explain multimedia database management system. What is collaborative computing?

Multimedia Database Management System (MMDBMS)

A Multimedia Database Management System is a specialised DBMS designed to store, manage, index and retrieve large volumes of heterogeneous multimedia data — text, images, audio, video and animation — along with descriptive metadata, in an efficient and organised manner.

Key features and requirements of an MMDBMS include:

- **Storage Management:** Handles massive files (BLOBs) using streaming-optimized storage structures.
- **Content-Based Retrieval:** Searches using actual media properties (color, shapes, melodies) instead of text.
- **Specialized Indexing:** Employs multidimensional structures (R-trees, kd-trees) for rapid similarity searches.
- **Synchronization Metadata:** Tracks timeline data to perfectly sync combined streams (like audio and video).
- **Query Support:** Solves complex searches based on spatial, temporal, and similarity relationships.
- **Compression-Aware Handling:** Streams and retrieves data progressively without full decompression. [

Collaborative Computing

Collaborative computing (also called groupware/CSCW – Computer-Supported Cooperative Work) refers to the use of computer systems and networks to enable multiple users, often at different locations, to work together on shared tasks, documents, or projects in real time or asynchronously.

Key characteristics include:

- **Shared workspace:** Common documents, whiteboards, or files that multiple users can view and edit simultaneously.
- **Communication tools:** Video conferencing, instant messaging, and audio/text chat that support real-time interaction among team members.
- **Coordination mechanisms:** Task scheduling, version control, and access management to coordinate contributions from multiple users without conflict.
- **Examples:** Video conferencing systems, collaborative document editors (e.g., shared word processors), online whiteboards, and project management/groupware platforms.

Q7. What is synchronization and what are synchronization issues? Explain abstraction levels of programming in multimedia system.

Synchronization and Its Issues

Synchronization in multimedia systems refers to maintaining the correct temporal (timing) relationships between different related media streams or objects, so that they are presented to the user in the intended order.

Common synchronization issues include:

- **Intra-stream Errors:** Delay variations between frames inside one stream, causing jerky playback.
- **Inter-stream Skew:** Misalignment between two separate streams, causing lip-sync bugs.
- **Network Jitter:** Unstable network arrival times that disrupt smooth data delivery.
- **Buffer Overflow/Underflow:** Bad memory caching that stalls playback or drops data.

Abstraction Levels of Programming in Multimedia Systems

Abstraction levels in multimedia programming define how close a developer is to the computer hardware versus the final creative user interface. Higher levels prioritize development speed and design, while lower levels prioritize performance and hardware control.

Here are the three abstraction levels summarized:

1. Low-Level Programming (Hardware & Driver Level)

- **Definition:** Directly manipulates hardware components like the CPU, GPU, or sound cards.
- **Languages:** Assembly, C.
- **Multimedia Use:** Writing device drivers, custom video codecs (H.264/AV1 compression), and low-level digital signal processing (DSP) algorithms.

2. Mid-Level Programming (API & Engine Level)

- **Definition:** Uses application programming interfaces (APIs) and software libraries that shield developers from direct hardware code.
- **Multimedia Use:** Handling 3D graphics rendering, hardware-accelerated video decoding, and spatial audio calculations. [

3. High-Level Programming (Authoring & Application Level)

- **Definition:** Uses graphical interfaces, scripting languages, and visual environments where the underlying code is fully hidden.
- **Tools/Languages:** Unity, Unreal Engine, Adobe Animate, Max/MSP, JavaScript (with HTML5 Canvas).

- **Multimedia Use:** Designing interactive user interfaces, orchestrating animations, routing media paths, and mapping game logic.

Q8. Explain multimedia development cycle. Explain the trends of multimedia application.

a) Multimedia Development Cycle

1. Requirement analysis and planning: Identifying project objectives, target audience, scope, and required resources/budget.
2. Design: Preparing storyboards, navigation flow, and interface design describing how content and interactivity will be structured.
3. Content collection and creation: Gathering or producing the required text, audio, video, image and animation assets.
4. Implementation/Assembly: Integrating media elements with an authoring tool, adding interactivity and synchronization as per the design.
5. Testing: Checking functionality, media playback quality, navigation, and usability across the intended platforms.
6. Delivery and Maintenance: Distributing the final product to users and updating/fixing it based on feedback received after release.

b) Trends in Multimedia Applications

- Streaming media and OTT platforms: Rapid growth of on-demand and live audio/video streaming using adaptive bit-rate technology.
- Mobile multimedia: Expanding use of multimedia applications on smartphones/tablets, supported by faster mobile processors and wireless networks (4G/5G).
- Virtual Reality (VR) and Augmented Reality (AR): Increasing use of immersive technologies in gaming, education, retail and training.
- Cloud-based multimedia services: Storage, processing and delivery of multimedia content via cloud platforms, enabling access from any device, anywhere.
- Artificial Intelligence integration: AI-driven recommendation systems, automatic captioning/translation, and content generation within multimedia applications.

Q9. Write short notes on: (any TWO)

a) User Friendliness as Primary Goal

User friendliness refers to designing a multimedia system or interface so that it is easy, comfortable, and efficient for users to learn and use, with minimal frustration or errors. It is considered a primary design goal because:

- It directly affects how successfully users can achieve their intended tasks with the system.
- A user-friendly design minimizes training time and reduces user errors, increasing overall productivity.
- It improves user satisfaction and encourages continued use/adoption of the application.
- It supports accessibility for users with varying levels of technical skill or physical ability.

Achieving user friendliness involves consistent design, clear navigation, immediate feedback, error prevention/recovery, and involving real users in usability testing throughout development.

b) Multimedia System Development Life Cycle

The multimedia system development life cycle (MSDLC) is the structured sequence of phases followed to design, build and deliver a multimedia application, generally comprising:

- Requirement analysis and planning — defining goals, audience and resources.
- Design — creating storyboards, navigation structure and interface layout.
- Content collection/creation — gathering the necessary text, audio, video, image and animation assets.
- Implementation/assembly — integrating media using authoring tools with added interactivity.
- Testing — verifying functionality, media quality, and usability.
- Delivery — distributing the final product to end-users.

This cycle is iterative, allowing revisions at earlier stages based on results from testing and evaluation, ensuring the final product meets user needs and quality standards.

c) Object-Oriented Approach

The object-oriented approach models a multimedia system as a collection of interacting objects, each encapsulating both media data and the operations/behaviour associated with it. Its core principles are:

- Encapsulation: Bundling media data and its associated methods into a single self-contained object, hiding internal implementation details.

- **Classes and objects:** Organising media elements into classes (templates) from which specific objects are instantiated.
- **Inheritance:** Allowing new, specialised media object types to be derived from existing classes, promoting code reuse.
- **Polymorphism:** Allowing different objects to respond appropriately and differently to the same method call (e.g., a “play()” method behaving differently for audio vs. video objects).

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Q.1. Define multimedia. Explain the components of multimedia. [2 + 8]

Definition: Multimedia is the combination of more than one media element such as text, graphics, audio, video and animation, integrated together with the help of a computer to create, store, present and communicate information in an interactive and effective way..

Components of Multimedia

1. Text: The most common and basic component of multimedia. It is used to give titles, headings, menus and detailed explanation of the content. Text can be plain, formatted, or hypertext (linked text that lets a user jump to another location).

- **2. Graphics/Images:** Still pictures, drawings, logos, charts and photographs used to make the content visually attractive and easy to understand. Graphics may be in bitmap (raster) or vector form.
- **3. Audio:** Sound elements such as music, narration, sound effects and speech that are added to make the presentation more informative and lively. Audio can be analog or digital.
- **4. Video:** A sequence of moving images/frames displayed with sound. Video is used to show real events, demonstrations, tutorials, or movies and greatly increases the impact of the presentation.
- **5. Animation:** The technique of creating an illusion of motion by displaying a series of still images (frames) rapidly one after another. It is used in cartoons, simulations, games and web design.
- **6. Interactivity:** The feature that allows the user to control the flow of the multimedia content, for example clicking buttons, selecting menus or using hyperlinks, which makes the application user-driven rather than linear.

Q.2. Define analog and digital data? What are the hardware requirement in multimedia?

- **Analog Data:** Data that is represented in the form of continuously varying physical quantities (such as voltage, sound waves). Analog signals can take any value within a range, e.g., sound from a microphone, an old cassette tape recording.
- **Digital Data:** Data that is represented in discrete, binary form (0s and 1s). Digital signals have only fixed, distinct values, e.g., data stored on a computer, CD, or DVD.

Hardware Requirements in Multimedia (8 marks)

A multimedia system needs certain hardware components to create, process, and present multimedia content. The major hardware requirements are:

- **1. Processor (CPU):** A fast, high-performance processor is required to handle the heavy processing load of audio, video and graphics.
- **2. Memory (RAM):** Large RAM is needed since multimedia files (audio, video, images) are big in size and require fast temporary storage during processing.
- **3. Storage Devices:** High-capacity hard disks, SSDs, CD/DVD/Blu-ray drives or pen drives are required to store large multimedia files.
- **4. Monitor/Display:** A high-resolution color monitor is required for clear display of graphics, animation and video.
- **5. Sound Card and Speakers:** A sound card converts digital audio signals to analog so that speakers/headphones can play sound.
- **6. Video/Graphics Card:** Required for fast rendering and smooth display of graphics, animation and video.
- **7. Input Devices:** Keyboard, mouse, scanner, digital camera, microphone and graphics tablet are used to capture text, image, and audio data.
- **8. Output Devices:** Printer, speaker, projector and plotter are used to present the final multimedia output.

Q.3. What is font and typeface? Explain the use of textual communications in multimedia.

- **Font:** A font is a set of characters (letters, numbers, symbols) of one particular size and style belonging to a typeface family, for example Times New Roman, 12 point, Bold. A font is defined by its typeface, size, weight and style.
- **Typeface:** A typeface is a design or family of related fonts that share the same basic visual appearance, for example Arial, Times New Roman, Calibri. A typeface can include many fonts of different sizes and styles (bold, italic, regular).

Use of Textual Communication in Multimedia (6 marks)

Text is the simplest and most widely used element of multimedia and plays an important role in communication. Its uses include:

- **1. Conveying Information:** Text is used to explain ideas, instructions, and detailed content that images or sound alone cannot express clearly.

- **2. Titles and Headings:** Used to introduce topics, chapters or sections, helping the user to navigate the content.
- **3. Menus and Buttons:** Text labels on buttons and menus guide the user on how to interact with the application.
- **4. Hypertext Links:** Text can be linked to other pages, documents, or media, allowing non-linear navigation within multimedia applications.
- **5. Captions and Labels:** Text is used to describe images, diagrams and charts, making them easier to understand..

q.4. Differentiate between vector and bitmap images with examples. [10]

Vector Image	Bitmap Image
Made up of mathematical formulas (paths, lines, curves) that define shapes.	Made up of a grid of tiny dots called pixels.
Object-oriented / geometric image	Raster image
Can be resized/scaled to any size without loss of quality.	Loses quality (becomes blurred/pixelated) when enlarged.
Generally small in size.	Generally large in size, especially at high resolution.
Easy to edit individual objects/shapes.	Difficult to edit individual pixels; editing affects the whole image area.
Resolution independent.	Resolution dependent.
Logos, icons, line art, illustrations, fonts.	Photographs, scanned images, realistic pictures.
Adobe Illustrator, CorelDRAW, Inkscape.	Adobe Photoshop, MS Paint, GIMP.
.ai, .svg, .eps, .cdr	.bmp, .jpg/.jpeg, .gif, .png, .tiff
A company logo designed in CorelDRAW that looks sharp at any size.	A digital photograph taken from a camera or scanner.

Q.5. What is audio digitization? Explain audio software and production with examples.

Audio Digitization

Audio digitization is the process of converting an analog (continuous) sound signal into digital (discrete binary) form so that it can be stored, processed and played back by a computer. It involves the following steps:

Explain audio software and production with examples.

Audio software is used to record, edit, mix and enhance sound for use in multimedia applications. Common examples include:

- **1. Adobe Audition:** Used for multi-track recording, editing, noise reduction and mixing of audio.
- **2. Audacity:** A free, open-source audio editor used for recording and editing sound with effects.
- **3. Cool Edit Pro / Sound Forge:** Used for professional audio editing, mastering and effects processing.

Audio production generally follows these stages:

- **1. Recording:** Capturing sound using a microphone and recording software/hardware.
- **2. Editing:** Trimming, arranging and cleaning the recorded audio, removing noise and unwanted parts.
- **3. Mixing:** Combining multiple audio tracks (voice, music, effects) and balancing their levels.
- **4. Mastering:** Final processing to optimize volume, tone and quality for the target playback medium.

Q.6. Explain software testing in detail with its types. [10]

Software testing is the process of evaluating and verifying that a software application or program works as expected, is free of defects/bugs, and meets the specified requirements before it is delivered to the user. It helps to ensure quality, reliability and correctness of a multimedia application or software product.

Types of Software Testing

- **1. Unit Testing:** Testing of individual components or modules of the software separately to check that each unit works correctly.
- **2. Integration Testing:** Testing performed after combining individual units/modules to check whether they work correctly together.
- **3. System Testing:** Testing the complete and fully integrated software product to evaluate its compliance with the specified requirements.
- **4. Acceptance Testing:** Testing carried out to determine whether the system satisfies the business/user requirements and is ready for delivery.

- **5. Alpha Testing:** Testing performed by the developers/internal testing team at the development site before releasing to outside users.
- **6. Beta Testing:** Testing performed by real/end users in a real environment after alpha testing, before final release.
- **7. Black Box Testing:** Testing the functionality of the software without knowledge of its internal code structure; focuses on input and output.
- **8. White Box Testing:** Testing the internal structure, logic and code of the software; also called structural or glass-box testing.
- **9. Regression Testing:** Re-testing the software after modification/bug-fix to ensure that existing functionality still works correctly.
- **10. Performance Testing:** Testing to check the speed, responsiveness, and stability of the software under a particular workload.

Q.7. Define data compression. Differentiate between lossless compression method and lossy compression method. [2 + 8]

Data Compression (2 marks)

Data compression is the process of reducing the size of a file/data by encoding information using fewer bits than the original representation, so that it takes less storage space and can be transmitted faster over a network.

Lossless vs Lossy Compression (8 marks)

Basis	Lossless Compression	Lossy Compression
Meaning	Compression method in which no data is lost; the original data can be exactly reconstructed.	Compression method in which some data is permanently lost/removed to achieve higher compression.
Quality	Original quality is fully preserved.	Some loss of quality occurs, though often not noticeable.
Compression ratio	Lower compression ratio (less size reduction).	Higher compression ratio (greater size reduction).
Reversibility	Fully reversible – exact original file can be recovered.	Not reversible – original file cannot be exactly recovered.
Usage	Used where exact data is essential, e.g., text, program files, medical images.	Used where minor quality loss is acceptable, e.g., photos, audio, video.
File formats/example	ZIP, PNG, GIF, FLAC	JPEG, MP3, MPEG

Q.8. Define multimedia network. Explain communication standards. [2 + 8]

Multimedia Network (2 marks)

A multimedia network is a communication network that is designed to transmit multiple types of data—text, graphics, audio, video and animation—simultaneously between computers,

Communication Standards (8 marks)

Communication standards are the set protocols/rules that ensure compatibility and proper data exchange between different devices and systems in a multimedia network. Important standards include:

- **1. TCP/IP:** The basic set of protocols used for data transmission and communication over the Internet, ensuring reliable delivery of data packets.
- **2. ISDN (Integrated Services Digital Network):** A standard that allows simultaneous digital transmission of voice, video and data over traditional telephone lines.
- **3. ATM (Asynchronous Transfer Mode):** A high-speed networking standard designed to carry voice, video and data traffic using fixed-size cells for efficient real-time transmission.
- **4. Ethernet:** A widely used LAN standard (IEEE 802.3) that defines wiring and signaling for the physical/data link layer of local networks.
- **5. MPEG (Moving Picture Experts Group):** A set of standards for compression and transmission of audio and video data (e.g., MPEG-1, MPEG-2, MPEG-4).
- **6. JPEG (Joint Photographic Experts Group):** A standard for compression of still images used widely in multimedia and web applications.
- **7. H.323/H.320:** Standards used for video conferencing and multimedia communication over packet-based and ISDN networks.
- **Accessibility standards** – for communication with people with disabilities
- **Customer service standards** – response times, tone, escalation procedures
- **Organizational communication policies** – internal guidelines for how a team or company communicates

Q.9. Define web based animation. What are the application of animation? [2 + 8]

Web-based Animation (2 marks)

Web-based animation is a type of animation that is created, delivered and displayed through web browsers using technologies such as GIF, Flash, CSS3, JavaScript or SVG, allowing moving graphics and interactive content to be viewed directly on websites.

Applications of Animation (8 marks)

- **1. Entertainment:** Used in cartoons, animated movies and television programs for storytelling and entertainment.

- **2. Education and E-learning:** Used to explain complex concepts, processes and simulations in an engaging visual manner for students.
- **3. Advertising and Marketing:** Used in banner ads, product demonstrations and promotional videos to attract customer attention.
- **4. Gaming:** Character movement, effects and game environments in video games are created using animation.
- **5. Web Design:** Used for interactive buttons, menus, loading indicators and visual effects on websites.
- **6. Simulation and Training:** Used to simulate real-life situations for training purposes, e.g., flight simulators, medical training.
- **7. Engineering and Architecture:** Used in CAD/CAM and architectural walkthroughs to visualize designs before construction.
- **8. Scientific Visualization:** Used to visualize scientific data, molecular structures, and natural phenomena for research and study.

Q.10. Write short notes on: (any TWO) [2×5]

a. Introduction to Flash

Adobe Flash (formerly Macromedia Flash) is a multimedia authoring and animation software that was widely used to create vector-based animations, interactive web content, games and multimedia presentations. It allowed developers to combine graphics, text, audio, video and ActionScript (a scripting language) to build interactive applications with small file sizes suitable for the web. Flash content was published in .swf format and played using the Flash Player plug-in in web browsers. It was popular for banner ads, interactive websites, e-learning modules and browser-based games. However, due to security issues, high battery consumption on mobile devices, and the rise of open standards like HTML5/CSS3/JavaScript, Adobe officially discontinued Flash Player support in December 2020.

b. Digital video format and technology

Digital video is a sequence of digital images (frames) displayed rapidly with synchronized audio to create the illusion of motion, stored and processed by a computer in binary form. Digital video technology involves capturing video using a digital camera or converting analog video into digital form, then compressing it using codecs to reduce file size for storage and transmission. Common digital video formats include AVI (Audio Video Interleave), MP4 (MPEG-4 Part 14), MOV (QuickTime), WMV (Windows Media Video), and MKV (Matroska). Each format uses specific compression standards (codecs) such as MPEG, H.264, or H.265 to balance video quality and file size. Digital video technology is widely

c. Morphing and inverse kinematics

Morphing is an animation technique in which one image or object is gradually and smoothly transformed into another image/object over a sequence of frames, commonly used in movies, advertisements and special effects to create seamless transitions (e.g., a face transforming into another face). Inverse Kinematics (IK) is a technique used in 3D animation where the animator moves the end point of a linked chain of objects (such as a hand or foot), and the software automatically calculates the required positions and angles of the connected joints/bones (such as the elbow and shoulder) to reach that position.

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Program:

Diploma in Information Technology/Computer Engineering

Q.1. List out and explain functions and applications of multimedia technology. [3 + 7]

Functions of Multimedia

- **1. To Inform:** Multimedia presents facts, news, and data to the user through text, image, audio and video.
- **2. To Educate:** Multimedia is used to teach concepts through interactive and illustrative content, making learning easier and more effective.
- **3. To Entertain:** Multimedia is used to provide entertainment through games, movies, music and animation.
- **4. To Communicate:** Multimedia enables effective communication of ideas and messages by combining several media elements together.

Applications of Multimedia

- **1. Education:** Used in e-learning, computer-based training (CBT), digital libraries and interactive tutorials to make learning more engaging.
- **2. Business and Corporate Presentation:** Used for advertisements, marketing, video conferencing, and business presentations.
- **3. Entertainment:** Used in movies, animated films, video games, and music production.
- **4. Science and Engineering:** Used for simulation, modelling, CAD/CAM design, and visualization of scientific data.
- **5. Medicine:** Used in medical imaging, surgery simulation, diagnosis training and patient education.
- **6. Public Places:** Used in kiosks at airports, museums, hotels and shopping malls to provide information and way-finding.
- **7. Home Use:** Used for entertainment, home shopping, digital photo/video albums and communication (video calls).

- **8. Virtual Reality:** Used to create simulated environments for training, gaming and design visualization.

Q.2. What is universal serial bus? Describe the Graphics Card and Graphics Processing Unit (GPU). [2 + 4 + 4]

Universal Serial Bus - USB (2 marks)

A Universal Serial Bus (USB) is a standard hardware interface/port used to connect external devices such as keyboard, mouse, printer, scanner, pen drive, camera and other peripherals to a computer.

Describe the Graphics Card and Graphics Processing Unit (GPU).

Graphics Card is a physical hardware component inside a computer, while a **Graphics Processing Unit (GPU)** is the programmable chip embedded on that card that handles the actual mathematical calculations for rendering images. [

Graphics Processing Unit (GPU)

The GPU is the "brain" of the visual system, explicitly engineered for parallel processing.

- **Architecture:** Contains thousands of small, efficient cores running simultaneously.
- **Function:** Executes repetitive mathematical calculations for 3D physics, geometry, and pixels.
- **Versatility:** Accelerates modern workloads like artificial intelligence, machine learning, and video rendering.

Graphics Card (Video Card)

The graphics card is the complete expansion board that houses the GPU and bridges it to the computer system.

- **VRAM:** Holds dedicated, high-speed Video RAM to store texture data and frame buffers.
- **Cooling:** Integrates heavy heat sinks and fans to manage thermal output during high loads.
- **Motherboard Interface:** Connects to the computer system via a high-bandwidth PCIe slot.
- **Display Outputs:** Features physical ports like HDMI and DisplayPort to send signals to monitors.

Q.3.What do you mean by textual communication? Explain text design guidelines in detail

Textual communication refers to the process of conveying information, ideas, and messages using written words/text as a medium, in the form of headings, paragraphs, labels, menus and hyperlinks within a multimedia application.

Explain text design guidelines in detail

- **1. Font Selection:** Choose a simple, readable font/typeface appropriate to the content and audience; avoid using too many different fonts in one document.
- **2. Font Size:** Use an appropriate font size for headings, subheadings and body text so that the text is clearly readable on screen.
- **3. Color and Contrast:** Use text color that contrasts well with the background color to ensure readability, e.g., dark text on a light background.
- **4. Alignment and Spacing:** Maintain proper alignment (left, center, justified) and adequate line/paragraph spacing to improve readability and avoid a cluttered look.
- **5. Text Hierarchy:** Use different sizes, weights (bold) and styles to distinguish headings, subheadings and body text, guiding the reader through the content.
- **6. Consistency:** Maintain a consistent style, font, and color scheme throughout the whole application/document.
- **7. White Space:** Leave sufficient blank space around text blocks so the page does not look overcrowded and the content is easy to scan.
- **8. Avoid Overuse of Capital Letters:** Excessive use of uppercase text reduces readability and can appear as if shouting; use it sparingly for emphasis only.

Q.4. Differentiate between bitmap and vector graphics. Explain graphics editing software.

Bitmap vs Vector Graphics .

Bitmap Graphics	Vector Graphics
Made up of a grid of pixels (dots).	Made up of mathematical paths, lines and curves.
Loses quality/becomes blurred when enlarged.	Can be scaled to any size without losing quality.
Usually large, depends on resolution.	Usually small, independent of size.
Photographs and realistic images.	Logos, icons and line-based illustrations.
.bmp, .jpg, .gif, .png	.ai, .svg, .eps, .cdr

Graphics Editing Software (5 marks)

Graphics editing software refers to computer programs/applications used to create, edit, and manipulate digital images and graphics. They provide tools for drawing, painting, retouching, resizing, applying filters/effects and combining multiple images into a single composition. Some common graphics editing software are:

- **1. Adobe Photoshop:** A widely used bitmap/raster image editing software used for photo editing, retouching, and creating digital art.
- **2. Adobe Illustrator:** A vector graphics editing software used to create scalable logos, icons and illustrations.
- **3. CorelDRAW:** A vector-based graphics design software used for illustration, page layout and image editing.
- **4. GIMP (GNU Image Manipulation Program):** A free and open-source raster graphics editor similar to Photoshop, used for photo retouching and image composition.
- **5. Inkscape:** A free, open-source vector graphics editor used to create scalable illustrations, logos and diagrams.

Q.5. What do you mean by digitization? Explain audio file format in detail. [3 + 7]

Digitization

Digitization is the process of converting analog data (continuous signals such as sound, image or video) into digital form (discrete binary values of 0s and 1s) so that it can be stored, processed, edited and transmitted by a computer.

Audio File Formats.

1. **WAV:** High-quality, uncompressed audio with large file sizes, used in Windows and professional editing.
2. **MP3:** Popular lossy compressed format that reduces file size with acceptable quality for music and streaming.
3. **AIFF:** High-quality, uncompressed format by Apple, mainly used on Mac systems.
4. **WMA:** Compressed format by Microsoft offering good quality at smaller sizes than MP3.
5. **MIDI:** Stores performance instructions (notes, timing) instead of actual sound, creating tiny file sizes.
6. **AAC:** Compressed format used by Apple and YouTube, providing better quality than MP3 at similar bitrates.
7. **FLAC:** Lossless compressed format that reduces file size with zero quality loss, favored by audiophiles.

Q.6. Define animation. Explain application areas of animation in detail. [2 + 8]

Animation is the technique of creating an illusion of movement by displaying a rapid sequence of still images or frames, each slightly different from the previous one, so that when played back continuously, the objects appear to move.

Application Areas of Animation .

- **1. Entertainment Industry:** Used to create animated movies, cartoons and television series for children and adults.
- **2. Education and E-learning:** Used to visually explain difficult concepts, processes and scientific phenomena to make learning interactive and easier to understand.
- **3. Advertising and Marketing:** Used in animated advertisements, product demonstrations and promotional banners to attract customer attention.
- **4. Gaming Industry:** Used to animate characters, environments and effects in video games, making them more realistic and engaging.
- **5. Web Design:** Used for interactive buttons, page transitions, loading indicators and animated banners on websites.
- **6. Simulation and Training:** Used in flight simulators, medical training and military training to simulate real-life scenarios safely.
- **7. Engineering and Architecture:** Used in CAD/CAM design and architectural walkthroughs to visualize a product or building before it is actually built.
- **8. Scientific and Medical Visualization:** Used to visualize molecular structures, surgical procedures, and natural phenomena for research and study purposes.

Q.7. Describe the concept of multimedia project development. Write the different types of software testing. [8 + 2]

Concept of Multimedia Project Development (8 marks)

Multimedia project development is a systematic process of planning, designing, producing, testing and delivering a multimedia application (such as e-learning software, a website, a game, or a presentation). It generally follows these phases:

Types of Software Testing (2 marks)

- ☐ **Planning and Analysis:** Defining the objective, target audience, scope, budget, and requirements of the multimedia project.
- ☐ **Design:** Creating the storyboard, flowchart, navigation structure, and interface design to organize content and user interaction.
- ☐ **Content Collection/Production:** Gathering and producing required media elements like text, images, audio, video, and animation.

- ❑ **Integration/Authoring:** Combining all media elements using authoring tools to build the interactive multimedia application.
- ❑ **Testing:** Checking the application for errors, broken links, compatibility issues, and proper functioning before release.
- ❑ **Delivery/Distribution:** Publishing and delivering the final product to target users via the web, physical media, or other channels.
- ❑ **Maintenance:** Updating and fixing the application after release based on user feedback and changing requirements

Write the different types of software testing.

- Unit Testing
- Integration Testing
- System Testing
- Acceptance Testing
- Alpha Testing and Beta Testing
- Black Box Testing and White Box Testing
- Regression Testing



Q.8. Define compression. Why multimedia compression is important? [2 + 2]

Compression (2 marks)

Compression is the process of reducing the size of a data file by encoding it using fewer bits than its original representation, so that it occupies less storage space and can be transmitted faster.

Importance of Multimedia Compression (2 marks)

Multimedia files (audio, video, image) are usually very large in size. Compression is important because it reduces storage space requirements, allows faster transmission of data over networks/the internet .

Differentiate between lossy and lossless compression.

Basis	Lossy Compression	Lossless Compression
Meaning	Permanently removes some data to achieve a higher compression ratio.	No data is lost; original file can be exactly reconstructed.
Quality	Some loss of quality, though often not very noticeable.	Original quality is fully preserved.
Compression ratio	Higher compression ratio.	Lower compression ratio.
Reversibility	Not reversible to the exact original.	Fully reversible to the exact original.
Examples	JPEG, MP3, MPEG	ZIP, PNG, FLAC

Q.9. Write short notes on: (any TWO) [2×5]

a. Media Composition

Media composition refers to the process of combining and arranging different media elements — text, graphics, audio, video and animation — into a single, well-organized multimedia presentation or application. It involves planning the layout, sequencing, timing and synchronization of each media element so that they work together effectively to communicate the intended message. Media composition is generally done using authoring software (such as Adobe Premiere, Director, or PowerPoint) which allows the designer to

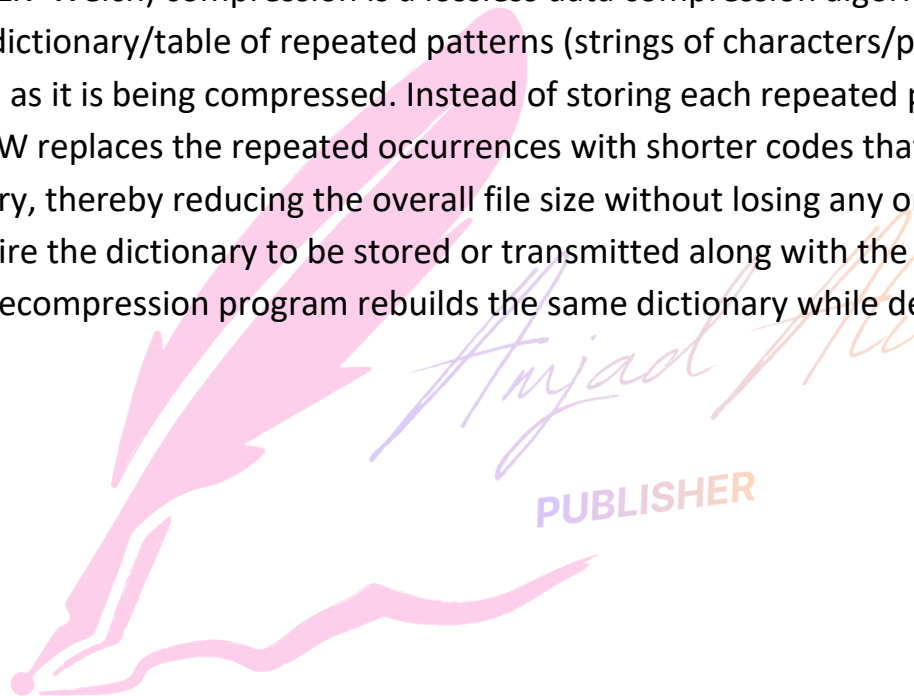
import, arrange, edit and synchronize different media on a timeline or storyboard. Good media composition ensures that the different elements do not conflict with each other,.

b. Sound/Audio System

A sound/audio system refers to the combination of hardware and software components used to capture, process, store, and play back sound in a multimedia system. The main components of an audio system include a microphone (to capture sound), a sound card (to convert analog signals to digital and vice versa), speakers/headphones (to play back sound), and audio editing software (to record, edit and enhance sound). The sound card performs digitization of analog audio input through an Analog-to-Digital Converter (ADC) and converts digital audio back to analog output through a Digital-to-Analog Converter (DAC).

c. LZW Compression

LZW (Lempel-Ziv-Welch) compression is a lossless data compression algorithm that works by building a dictionary/table of repeated patterns (strings of characters/pixels) found in the input data as it is being compressed. Instead of storing each repeated pattern separately, LZW replaces the repeated occurrences with shorter codes that reference the dictionary entry, thereby reducing the overall file size without losing any original data. It does not require the dictionary to be stored or transmitted along with the compressed file, because the decompression program rebuilds the same dictionary while decoding.



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Q.1. Define Multimedia. Explain various multimedia component.

Definition of Multimedia

Multimedia is defined as the integration of multiple forms of media - text, graphics, audio, video and animation - combined together with the help of a computer to create, store, present, and communicate information in an interactive and effective way.

Components of Multimedia

- **Text** - words, headings and labels that convey detailed information.
- **Graphics/Images** - still pictures and drawings that make content visually attractive.
- **Audio** - sound, music, and narration that add realism and clarity.
- **Video** - moving images with synchronized sound used to show real events.
- **Animation** - sequence of still images played rapidly to create an illusion of motion. Distinct from video (which is often filmed) since animation is typically created frame-by-frame or via keyframes/tweening
- What separates *interactive* multimedia from *linear* multimedia
- Allows the user to control the experience — clicking, navigating, inputting data (e.g., in games, websites, e-learning tools)

Q.2. Explain speech Generation. How does sound be represented digitally? [5 +

Speech Generation (5 marks)

Speech generation (also called speech synthesis or text-to-speech, TTS) is the artificial production of human speech by a computer system. It converts written text into spoken words so that the computer can “talk” to the user. The process generally involves the following steps:

- **1. Text Analysis:** The input text is analyzed to identify words, sentence structure, abbreviations and punctuation.
- **2. Phonetic/Linguistic Conversion:** The text is converted into phonemes (basic units of sound) using pronunciation rules.
- **3. Prosody Generation:** Pitch, stress, rhythm and intonation are added to make the speech sound natural.
- **4. Waveform Generation:** The phonemes and prosody information are used to generate the actual audio waveform, using methods such as concatenative synthesis (joining pre-recorded speech units) or formant synthesis (generating speech using acoustic models).

Digital Representation of Sound (5 marks)

Sound in nature is an analog (continuous) signal, so it must be converted to digital form before a computer can store or process it. This is done through the following steps:

- **1. Sampling:** The amplitude of the analog sound wave is measured at regular time intervals; the number of samples taken per second is called the sampling rate (e.g., 44.1 kHz for CD-quality audio).
- **2. Quantization:** Each sample value is rounded/mapped to the nearest available digital value, based on the bit depth (e.g., 8-bit, 16-bit); higher bit depth gives higher sound quality.
- **3. Encoding:** The quantized sample values are encoded into binary form and stored in a digital audio format (e.g., WAV, MP3) using an Analog-to-Digital Converter (ADC)..

Q.3. What is Image Analysis and Image Transmission. [5 + 5]

Image Analysis (5 marks)

Image analysis is the process of extracting meaningful information, features, or patterns from a digital image using computer techniques, in order to understand, interpret, or make decisions based on the image content. It typically involves the following operations:

- **1. Image Enhancement:** Improving the visual quality of an image (contrast, brightness, sharpness).
- **2. Edge Detection:** Identifying boundaries of objects within an image.
- **3. Segmentation:** Dividing an image into meaningful regions or objects for further analysis.
- **4. Feature Extraction:** Identifying important characteristics such as shape, color, or texture.
- **5. Pattern Recognition:** Classifying or identifying objects within the image.

Image Transmission (5 marks)

Image transmission is the process of sending image data from one location/device to another over a communication network (LAN, WAN, or the Internet). Since images can be very large in file size, image transmission generally involves the following

- 1. Compression:** Images are compressed (e.g., JPEG, PNG) before transmission to reduce file size and save bandwidth/time.
- **2. Bandwidth Requirement:** Sufficient network bandwidth is required for fast and smooth transmission, especially for high-resolution images.
- **3. Progressive Transmission:** Some formats allow the image to be sent and displayed gradually (low resolution first, then refined), so users can view a rough version early.
- **4. Error Detection/Correction:** Techniques are used to detect and correct errors that may occur during transmission over the network. ☐ Images are data-heavy (a single uncompressed photo can be several MB)

Q.4. What do you mean by Data compression? Differentiate between lossless and lossy compression with suitable examples. [2+4+4]

Computer Based Animation

Computer-based animation refers to the technique of using computer software to create a sequence of images/frames that are displayed rapidly one after another to produce the illusion of motion.

Discuss on the animation languages and transmission of animation on brief with suitable examples

Animation languages are specialized programming/scripting languages used to define, control and generate the behavior and movement of objects in a computer animation. Examples include:

- ASAS (Actor Script Animation Language) - an early scripting language for controlling animated actors/objects.
- Lingo - the scripting language used in Macromedia/Adobe Director for controlling multimedia and animation.
- ActionScript - the scripting language used in Adobe Flash for creating interactive web-based animation.
- MEL (Maya Embedded Language) - a scripting language used in Autodesk Maya to automate and control 3D animation.

Transmission of Animation.

Transmission of animation refers to the process of delivering animated content from a server/source to the end user, typically over the Internet, so that it can be viewed on a web browser or device.

Examples include animated GIFs and Flash (.swf) animations shown on websites, and streamed animated videos on platforms such as YouTube.

Q.5. What do you mean by Data compression? Differentiate between lossless and lossy compression with suitable examples. [2 + 4 + 4]

Data Compression (2 marks)

Data compression is the process of reducing the size of a file/data by encoding it using fewer bits than its original representation, so that it requires less storage space and can be transmitted faster over a network.

Feature	Lossless Compression	Lossy Compression
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Definition	Reduces file size by removing data redundancies without losing any information.	Reduces file size by permanently discarding unnecessary or unnoticeable data.
Data Recovery	100% reversible; decompresses back to the exact original state.	Irreversible; discarded data cannot be recovered upon decompression.
File Size	Larger compressed files (typically 2:1 or 3:1 reduction ratios).	Significantly smaller compressed files (often 10:1 or higher reduction ratios).
Quality	Zero quality degradation; identical to the original file.	Reduced quality, though often optimized to be unnoticeable to humans.
Algorithm Examples	Huffman Coding, LZW, Run-Length Encoding (RLE).	Transform Coding (DCT), Quantization, Psychoacoustic Modeling.
Text/Code Formats	ZIP, RAR, 7z, GZ (Crucial because a single altered character ruins text).	<i>Not applicable</i> (Using lossy compression on text makes it unreadable).
Image Examples	PNG, GIF, TIFF, BMP (Best for logos, charts, and crisp graphics).	JPEG, WebP (Best for photographs and web graphics to load quickly).
Audio Examples	FLAC, ALAC, WAV (Preferred for studio archiving and audiophiles).	MP3, AAC, OGG (Standard for streaming platforms and mobile devices).
Video Examples	FFV1, Apple ProRes HQL (Used in professional video editing).	MP4, MKV, AV1 (Used by Netflix, YouTube, and digital broadcasting).
Primary Use Cases	Medical imaging, databases, executable software, archival storage.	Web streaming, online video, social media uploads, everyday storage.

Q.6. Define multimedia design. Explain development phases of multimedia. [2 + 8]

Multimedia Design

Multimedia design is the process of planning and structuring how different media elements (text, graphics, audio, video, animation) and interactive features of a multimedia application will be organized, presented and linked together to effectively communicate information and provide a good user experience.

Development Phases of Multimedia (8 marks)

- **1. Planning and Analysis:** Defining the objective, target audience, scope, timeline and budget of the multimedia project, and analyzing the requirements.
- **2. Design:** Creating the storyboard, flowchart and interface/navigation design that shows how content will be organized and how users will interact with it.
- **3. Content Collection/Production:** Gathering or producing the required media elements (text, graphics, audio, video, animation) using appropriate tools.
- **4. Integration/Authoring:** Assembling and combining all the media elements using an authoring tool to build the complete interactive application.
- **5. Testing:** Checking the application for functional errors, broken links, compatibility problems and overall usability before release.
- **6. Delivery:** Publishing/distributing the finished multimedia product to the target users, through CD/DVD, the web, or other media.
- **7. Maintenance:** Updating, fixing and improving the application after release, based on feedback and changing requirements.

Q.7. Explain about the Multimedia Communication System. Discuss about Multimedia Database Management System with examples. [2 + 8]

Multimedia Communication System.

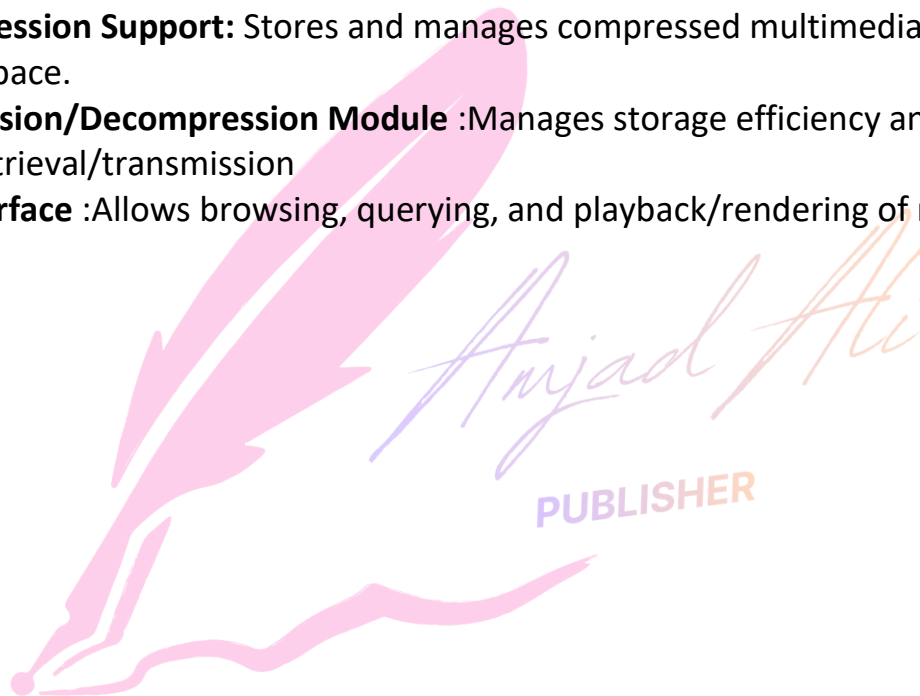
A multimedia communication system is a system that enables the transmission, exchange and synchronized delivery of multiple media types - text, audio, video, and image - between two or more users/devices over a communication network, such as in video conferencing, IPTV or Voice over IP (VoIP).

Multimedia Database Management System (8 marks)

A Multimedia Database Management System (MMDBMS) is a database system specifically designed to efficiently store, manage, organize, and retrieve multimedia data types such as text, images, audio, video and animation, in addition to traditional structured data.

Key features of a Multimedia Database Management System include:

- **1. Storage of Large Objects:** Supports storage of large binary objects (BLOBs) to hold images, audio and video data.
- **2. Content-Based Retrieval:** Allows searching and retrieving multimedia data based on its actual content (e.g., color, shape, or a sample audio clip) rather than just by keyword/filename.
- **3. Indexing:** Provides specialized indexing techniques for fast searching of multimedia content.
- **4. Synchronization Support:** Manages temporal relationships between different media (e.g., keeping audio and video in sync).
- **5. Compression Support:** Stores and manages compressed multimedia data to save storage space.
- **Compression/Decompression Module :**Manages storage efficiency and bandwidth during retrieval/transmission
- **User Interface :**Allows browsing, querying, and playback/rendering of multimedia



Q.8. Differentiate between Hypertext and Hypermedia. Explain Open Document Architecture. [5 + 5]

Hypertext vs Hypermedia (5 marks)

Hypertext	Hypermedia
Text that contains links to other text/documents, allowing non-linear navigation.	An extension of hypertext that links text along with graphics, audio, video and animation.
Only text-based content.	Multiple media types: text, image, audio, video, animation.
User navigates only between linked text/documents.	User navigates between different linked media elements.
Less rich, limited to textual information.	More rich and interactive due to multiple media types.
Wikipedia article text with links to other articles.	A multimedia encyclopedia (e.g., Encarta) with linked text, images, video and sound.

Open Document Architecture - ODA (5 marks)

Open Document Architecture (ODA) is an ISO standard that defines a format for representing and exchanging compound documents (documents that contain a mixture of text, graphics and images) between different computer systems, or content.

ODA defines a document using two main structures:

- **1. Logical Structure:** Describes the organization of the document's content in terms of logical components such as chapters, sections, paragraphs and headings.
- **2. Layout Structure:** Describes how the document content is physically arranged on the page, such as pages, frames, and blocks.

ODA also supports a content architecture, which defines how the actual content (character/text content, raster graphics content, geometric graphics content) is represented.

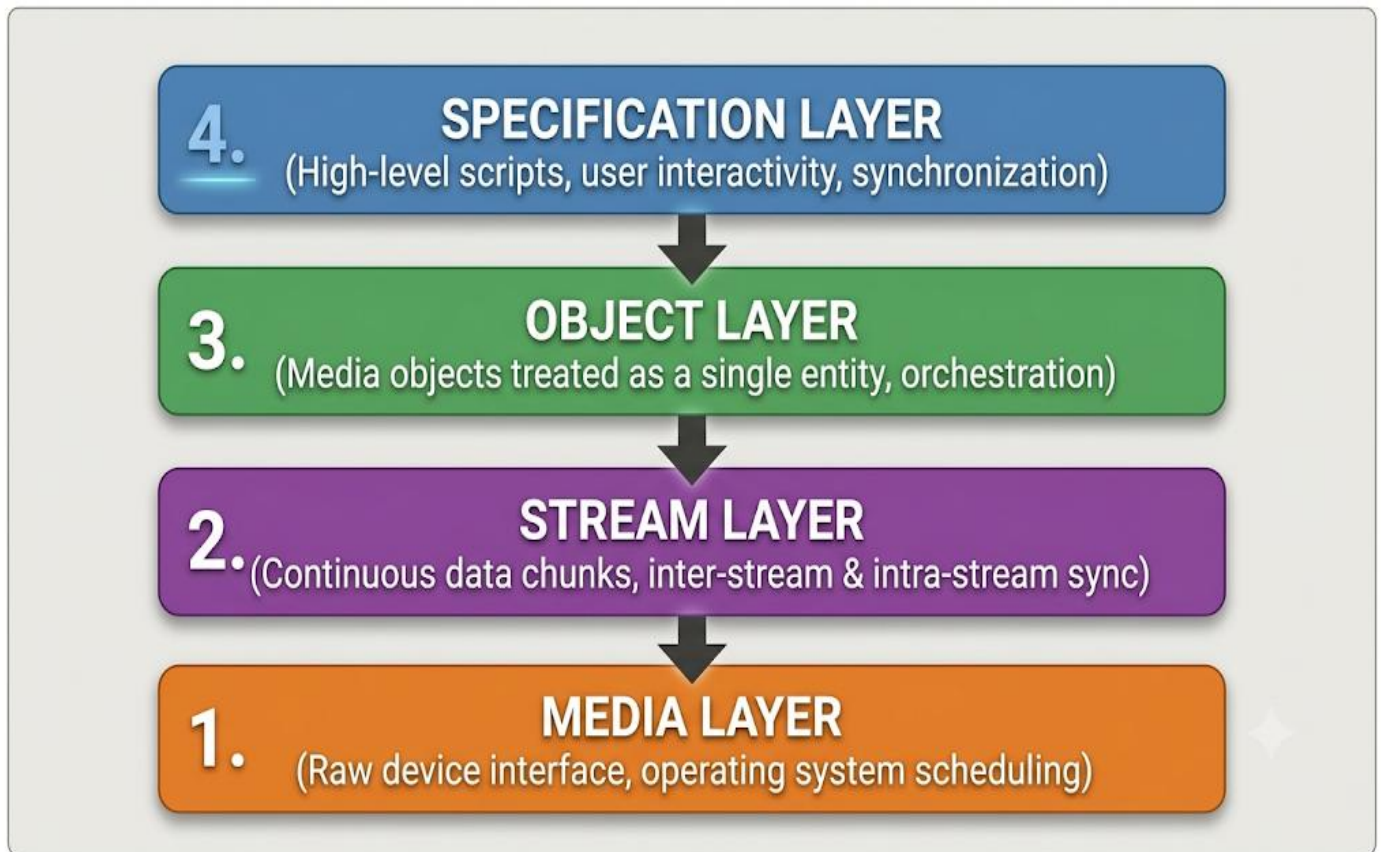
Logical Structure

- Describes the document's *content organization* — chapters, sections, paragraphs, headings, footnotes

- Independent of how it looks on a page — this is about meaning/hierarchy, similar to how HTML tags describe structure rather than appearance

Q.9. Describe about the four-layer synchronization reference model.

Synchronization in multimedia refers to maintaining the correct timing relationship between different media elements (e.g., keeping audio and video in sync) during storage, transmission and playback.



1. Media Layer (Physical)

Handles raw digital frames or audio samples individually. It maintains the base playback speed inside a single, continuous stream.

2. Stream Layer (Packet)

Packages media data into timed packets. It keeps the flow smooth by delivering consecutive frames at the correct intervals.

3. Object Layer (Inter-media)

Coordinates timing between different, related media streams. It ensures parts match up correctly, like syncing an audio voice track to lip movements in a video.

4. Specification Layer (Application)

Defines the overall script for the entire presentation. It uses high-level rules to dictate exactly when slides, sounds, and animations appear together.

Q.10. Write short notes on: (Any Two) [2×5 = 10]

a. Trends in Multimedia Application

Multimedia technology is continuously evolving, and several important trends can be seen in its application. Mobile multimedia has grown rapidly, with smartphones and tablets now being used to create, view and share multimedia content anywhere. Streaming media (audio/video streaming through platforms such as YouTube and Netflix) has replaced traditional download-based access, allowing instant playback over the Internet.

b. Object Oriented Approaches

The object-oriented approach in multimedia refers to designing and developing multimedia systems and applications by representing different media elements (text, image, audio, video) and their behavior as objects, similar to object-oriented programming. Each media element is treated as an object having its own properties (attributes) and methods (behavior/operations), and objects can be grouped into classes and can inherit properties from other classes..

c. Toolkits

A multimedia toolkit is a collection of pre-built software components, functions, libraries and utilities that provide ready-made building blocks (such as buttons, media players, animation controls, and communication modules) for developing multimedia applications, without requiring the developer to write every function from scratch. Toolkits simplify and speed up the process of multimedia application development by allowing

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Q.1. 1. Define multimedia. Write the components of multimedia. Explain the application of multimedia. [2+2+6].

Multimedia is the combination of more than one media element - such as text, graphics, audio, video and animation - integrated together with the help of a computer to create, store, present, and communicate information in an interactive and effective way.

Components of Multimedia (2 marks)

- Text.
- Graphics/Images
- Audio:
- Videomoving images,
- Animations.

Explain the application of multimedia.

- **1. Education:** Used in e-learning, computer-based training and digital libraries to make learning interactive and effective.
- **2. Business:** Used in advertisements, marketing presentations, and video conferencing for corporate communication.
- **3. Entertainment:** Used in movies, animated films, music and video games.
- **4. Science and Engineering:** Used for simulation, modelling, CAD/CAM design and visualization of data.
- **5. Medicine:** Used in medical imaging, surgery simulation and patient education.
- **6. Public Places:** Used in information kiosks at airports, museums, and shopping malls.

Q.2. What is analog and digital data? Explain about USB, graphics card and graphical processing unit (GPU). [4 + 6]

Analog and Digital Data (4 marks)

- **Analog Data:** Data represented in the form of continuously varying physical quantities, such as voltage or sound waves. Analog data can take any value within a range, e.g., sound recorded on an old cassette tape.
- **Digital Data:** Data represented in discrete, binary form using 0s and 1s. Digital data has only fixed, distinct values, e.g., data stored on a computer, CD, or DVD.

The main difference is that analog data varies continuously, whereas digital data has discrete, well-defined values, which makes digital data easier to store, process, edit and transmit without loss of quality using a computer.

USB, Graphics Card, and GPU (6 marks)

- **Universal Serial Bus (USB):** USB is a standard hardware interface/port used to connect external peripheral devices such as a keyboard, mouse, printer, scanner, pen drive and camera to a computer. It supports plug-and-play connectivity and.
- **Graphics Card:** A graphics card (video card/display adapter) is a hardware component that generates and renders images, video and animation to be displayed on the monitor.
- **Graphics Processing Unit (GPU):** A GPU is a specialized processor/chip designed to perform the rapid mathematical calculations required for rendering graphics, video and animation.

Q.3. Differentiate between hypertext and hypermedia. Write the guidelines for text design. [5 + 5]

Hypertext vs Hypermedia .

Hypertext	Hypermedia
Text containing links to other text/documents, allowing non-linear navigation.	An extension of hypertext that links text along with graphics, audio, video and animation.
Only text-based content.	Multiple media types: text, image, audio, video, animation.
User navigates only between linked text/documents.	User navigates between different linked media elements.
Less rich, limited to textual information.	More rich and interactive due to multiple media types.
A Wikipedia article with links to other articles.	A multimedia encyclopedia with linked text, images, video and sound.

Guidelines for Text Design.

- **1. Font Selection:** Use a simple, readable font suitable to the content and audience; avoid mixing too many fonts.
- **2. Font Size:** Use an appropriate size for headings, subheadings and body text for clear readability.
- **3. Color and Contrast:** Use text color that contrasts well with the background to ensure readability.
- **4. Alignment and Spacing:** Maintain proper alignment and line/paragraph spacing to avoid a cluttered look.
- **5. Consistency:** Maintain a consistent style, font and color scheme throughout the application.
- **6. White Space:** Leave sufficient blank space around text so the content is easy to scan.
- **7. Conciseness:** Keep text short, clear and to the point, especially in screen-based content.

Q.4. List the different graphics editing software. Differentiate between raster and vector image with example. [5 + 5]

Graphics Editing Software (5 marks)

- Adobe Photoshop - raster/bitmap image editing and photo retouching.
- Adobe Illustrator - vector graphics design for logos and illustrations.
- CorelDRAW - vector-based illustration and page layout design.
- GIMP - free, open-source raster image editor similar to Photoshop.
- Inkscape - free, open-source vector graphics editor.

Raster vs Vector Image (5 marks)

Basis	Raster (Bitmap) Image	Vector Image
Composition	Made up of a grid of pixels (dots).	Made up of mathematical paths, lines and curves.
Scaling	Loses quality/becomes blurred when enlarged.	Can be scaled to any size without losing quality.
File Size	Usually large, depends on resolution.	Usually small, independent of size.
Suitable For	Photographs and realistic images.	Logos, icons and line-based illustrations.
Example	A digital photograph saved as .jpg or .png.	A company logo designed in CorelDRAW/.svg format.

Q.5. Define and explain audio digitization. Write about audio file formats. [6 + 4]

Audio Digitization (6 marks)

Audio digitization is the process of converting an analog (continuous) sound signal into digital (discrete binary) form so that it can be stored, processed, edited, and played back by a computer. It involves the following steps:

- **1. Sampling:** Measuring the amplitude of the analog sound wave at regular time intervals; the number of samples taken per second is the sampling rate (e.g., 44.1 kHz for CD quality).
- **2. Quantization:** Assigning a numeric (binary) value to each sample based on the bit depth (e.g., 16-bit); a higher bit depth gives better sound quality.
- **3. Encoding:** Converting the quantized sample values into a digital audio format/file (e.g., WAV, MP3) using an Analog-to-Digital Converter (ADC).

During playback, the digital audio data is converted back to an analog signal using a Digital-to-Analog Converter (DAC), so it can be played through speakers or headphones.

Audio File Formats (4 marks)

- **1. WAV:** An uncompressed format offering high sound quality but large file size; widely used in Windows systems.
- **2. MP3:** A widely used lossy compressed format that reduces file size while keeping acceptable sound quality; popular for music and streaming.
- **3. AIFF:** An uncompressed audio format developed by Apple, similar to WAV, mainly used on Macintosh systems.
- **4. MIDI:** A format that stores instructions (notes, timing, instrument) rather than actual sound, resulting in very small file size.
- **5. FLAC:** A lossless compressed format that reduces file size without losing any audio quality.

Q.6. What is animation? Explain the principles of animation. List application of animation.

Animation.

Animation is the technique of creating an illusion of movement by displaying a rapid sequence of still images/frames, each slightly different from the previous one, so that when played continuously, the objects appear to move.

Principles of Animation (6 marks)

- **1. Squash and Stretch:** Giving an object a sense of weight and flexibility by deforming its shape during motion.
- **2. Anticipation:** Preparing the viewer for a major action by showing a small, opposite movement just before it.
- **3. Staging:** Presenting an idea/action clearly so that the viewer's attention is directed to the important part of the scene.

- **4. Timing:** Controlling the number and spacing of frames to determine the speed and weight of an action.
- **5. Follow Through and Overlapping Action:** Continuing the movement of parts of an object after the main action has stopped, so it does not look stiff.
- **6. Slow In and Slow Out (Ease In/Out):** Adding more frames near the start and end of an action and fewer in the middle, so that motion accelerates and decelerates naturally rather than moving at a constant speed.
- **7. Exaggeration:** Slightly exaggerating actions/expressions to make the animation more appealing and expressive.

Applications of Animation.

- Entertainment (movies, cartoons)
- Education/e-learning
- Advertising and marketing
- Gaming
- Web design and simulation/training

Q.7. What is software testing? List the different software testing. Write about the compression techniques used in multimedia. [2 + 3 + 5]

Software Testing

Software testing is the process of evaluating and verifying that a software application works as expected, is free of defects/bugs, and meets the specified requirements before it is delivered to the user.

Types of Software Testing

- Unit Testing
- Integration Testing
- System Testing
- Acceptance Testing
- Alpha Testing and Beta Testing
- Black Box Testing and White Box Testing
- Regression Testing

Compression Techniques used in Multimedia

- **Run Length Encoding (RLE):** Lossless; replaces repeated data sequences with a single value and count (e.g., solid color images).
- **Huffman Coding:** Lossless; assigns shorter binary codes to frequent data and longer codes to rare data.
- **LZW Compression:** Lossless; builds a pattern dictionary to replace repeated data with shorter codes (used in GIF, TIFF).
- **Discrete Cosine Transform (DCT):** Lossy; transforms data into frequency components and discards high-frequency details (used in JPEG).
- **MPEG Compression:** Lossy; removes spatial redundancy within frames and temporal redundancy between consecutive video frames.

Q.8. Write short notes on: (any TWO) [2×5]**a. Multimedia Network**

A multimedia network is a communication network designed to transmit multiple types of data - text, graphics, audio, video and animation - simultaneously between computers, allowing multimedia applications and content to be shared, accessed and delivered over a network such as a LAN, WAN or the Internet. Since multimedia data (especially audio and video) is large in size and time-sensitive,

b. Font and Typeface

A font is a set of characters (letters, numbers and symbols) of one particular size and style belonging to a typeface family, for example Times New Roman, 12 point, Bold. A font is defined by its typeface, size, weight (bold/regular) and style (italic/normal). A typeface, on the other hand, is a design or family of related fonts that share the same basic visual appearance, for example Arial,

c. Computer Color

Computer color refers to the way color is represented, generated and displayed digitally on a computer system. Colors on a computer screen are generated by combining different intensities of red, green and blue light (the RGB color model), where each pixel's color is determined by the combination of these three primary colors, typically represented using 8 bits per channel (24-bit color, giving over 16 million possible colors

d. Photoshop

Adobe Photoshop is a popular raster/bitmap graphics editing software developed by Adobe Systems, widely used for photo editing, image retouching, digital painting, and graphic design in multimedia applications. It provides a wide range of tools and features such as layers (to work on different parts of an image independently), selection tools, cropping and resizing, color correction, filters and effects,

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Q.1. What are the uses of multimedia? Explain multimedia system and its properties.

Uses of Multimedia

- **1. To Inform and Communicate:** Multimedia conveys facts, news, and messages effectively by combining text, sound, image and video.
- **2. To Educate and Train:** Multimedia is used in e-learning, tutorials and simulations to make learning interactive and easy to understand.
- **3. To Entertain:** Multimedia is used in movies, games, music and animation for entertainment purposes.

Multimedia System and its Properties

A multimedia system is a computer-controlled system that is capable of creating, storing, presenting, manipulating and communicating independent, digitally represented data in more than one media type, such as text, graphics, audio, video and animation, in an integrated manner.

Properties of a multimedia system include:

- **1. Combination of Media:** It must support at least one continuous (time-based, e.g., audio/video) and one discrete (time-independent, e.g., text/image) media type.
- **2. Integration:** Multiple media types are combined together into a single, unified presentation.
- **3. Digital Representation:** All media elements are represented and processed in digital (binary) form.
- **4. Interactivity:** The user can control the flow of information, make choices and interact with the content.
- **5. Synchronization:** The system must maintain proper timing relationships between different media, e.g., keeping audio and video in sync.

Q.2. What is sound/audio system? Explain speech generation and analysis. [2 + 8]

Sound/Audio System.

A sound/audio system refers to the combination of hardware (microphone, sound card, speakers) and software used to capture, process, store and play back sound in a multimedia system, allowing narration, music and sound effects to be added to multimedia applications.

Speech Generation and Analysis (8 marks)

Speech Generation (Text-to-Speech, TTS) is the artificial production of human speech by a computer, converting written text into spoken words. It generally involves:

- **1. Text Analysis:** The input text is analyzed to identify words, sentence structure, abbreviations and punctuation.
- **2. Phonetic Conversion:** The text is converted into phonemes (basic sound units) using pronunciation rules.
- **3. Prosody Generation:** Pitch, stress and intonation are added to make the speech sound natural.
- **4. Waveform Generation:** The final audio waveform is generated using concatenative synthesis (joining pre-recorded speech units) or formant synthesis (generating sound using acoustic models).

Speech Analysis (Speech Recognition) is the reverse process - converting spoken/audio input into text or commands that a computer can understand and process. It generally involves:

- **1. Acoustic Analysis:** The incoming audio signal is captured and analyzed to identify sound patterns/frequencies.
- **2. Feature Extraction:** Important acoustic features are extracted from the speech signal.
- **3. Pattern Matching/Recognition:** The extracted features are compared against a database of known speech patterns/models to identify the corresponding words.
- **4. Language Modeling:** Grammar and context rules are applied to improve the accuracy of the recognized text.

Q.3. How can you represent a digital image? Explain image synthesis

Representation of a Digital Image.

A digital image is represented as a two-dimensional matrix/grid of small picture elements called pixels, where each pixel holds a numeric value representing its color/intensity.

Digital Image Properties

1. **Resolution:** Number of pixels (width $\times$ height, e.g., 1920×1080); higher resolution means sharper detail.
2. **Bit Depth:** Number of bits per pixel; higher bit depth represents more colors/shades (e.g., 24-bit RGB).
3. **Color Model:** System used to represent colors, such as **RGB** for digital screens and **CMYK** for printing.

Explain image synthesis

Image synthesis is the process of artificially generating a new image using a computer, based on mathematical models, algorithms and rules, rather than capturing it directly from the real world with a camera or scanner

- **Modeling:** Creating geometric or mathematical descriptions of objects and scenes (shapes, surfaces, textures).
- **Rendering:** Converting a 3D scene into a 2D image by calculating light interaction using techniques like ray tracing or rasterization.
- **Texturing & Shading:** Applying colors, surface patterns, and lighting effects to give objects a realistic appearance.
- **Procedural Generation:** Using algorithms and rules to automatically create complex textures or landscapes (e.g., clouds, terrain).

Q.4. What do you mean by Computer-Based animation? What are the methods of controlling animation?
[2 + 8]

Computer-Based Animation (2 marks)

Computer-based animation refers to the technique of using computer software to create a sequence of images/frames that are displayed rapidly one after another to produce the illusion of motion, instead of drawing each frame manually as in traditional animation.

- **Keyframe Animation:** Animator sets main frames (*keyframes*); software automatically generates in-between frames (*tweening*).
- **Procedural Animation:** Motion is generated automatically using mathematical algorithms (e.g., fire, water, smoke).
- **Motion Capture (MoCap):** Tracks real human/object movement using sensors and maps it onto 3D digital characters.
- **Kinematics (FK & IK):**
- **Forward Kinematics (FK):** Position calculated joint-by-joint from root to tip.
- **Inverse Kinematics (IK):** End-point is moved directly; software calculates joint angles.
- **Scripting Languages:** Uses code/scripts (e.g., ActionScript, MEL, Python) to control object behavior and events.
- **Physics-Based Animation:** Simulates real-world laws like gravity, friction, and collisions for natural motion.
- **Morphing:** Smoothly transforms one shape or image into another over a sequence of frames.

Q.5. What is the purpose of data compression? Explain LZW compression. [4 + 6]

Purpose of Data Compression

1. **Reduces Storage Space:** Compressed files take up less disk space, maximizing the storage capacity of hardware.
2. **Faster Transmission:** Smaller file sizes transfer significantly faster over networks with limited bandwidth.
3. **Reduces Cost:** Lowering storage and bandwidth requirements directly cuts hardware and data transfer expenses.
4. **Efficient Streaming:** Enables smooth, real-time playback of multimedia files (audio/video) over the internet without buffering.

LZW Compression (6 marks)

LZW (Lempel-Ziv-Welch) compression is a lossless data compression algorithm that works by building a dictionary/table of repeated patterns (strings of characters or pixel sequences) found in the input data as it is being compressed. The algorithm works as follows:

- **Dictionary Initialization:** Starts by pre-loading the dictionary with all single characters (e.g., standard 256 ASCII characters).
- **Pattern Scanning:** Scans input data sequentially to identify recurring character sequences and assigns new, unique codes to unseen patterns.
- **Code Replacement:** Replaces repeated character patterns already present in the dictionary with their shorter corresponding code.
- **Decompression:** Reconstructs the exact same dictionary dynamically during decoding, eliminating the need to store or send the dictionary with the file.
- **Advantages**
 - Simple and fast to implement
 - No prior knowledge of data statistics needed (unlike Huffman coding)
 - Good compression ratio for structured/repetitive content

Q.6. What is hypermedia? Explain document architecture ODA. [2 + 8]

Hypermedia.

Hypermedia is an extension of hypertext in which links connect not only text but also other media elements such as graphics, images, audio, video and animation, allowing the user to navigate non-linearly between different multimedia content.

Open Document Architecture - ODA .

Open Document Architecture (ODA) is an ISO standard that defines a format for representing and exchanging compound documents (documents containing a mixture of text, graphics and images) between different computer systems, software applications and

devices, independent of the hardware/software platform on which the document was created.

ODA represents a document using the following structures:

- **Logical Structure:** Hierarchical organization of content by meaning (e.g., chapters, sections, paragraphs).
- **Layout Structure:** Physical visual arrangement on media (e.g., pages, frames, blocks).
- **Content Architecture:** Internal encoding for media types (character text, raster graphics, vector graphics).

Q.7. Define user interface. Explain about HTML and SGML.

User Interface.

A user interface (UI) is the means by which a user interacts with a computer system or application, including the visual elements (menus, buttons, icons) and the way the user provides input and receives output,

. Standard Generalized Markup Language (SGML)

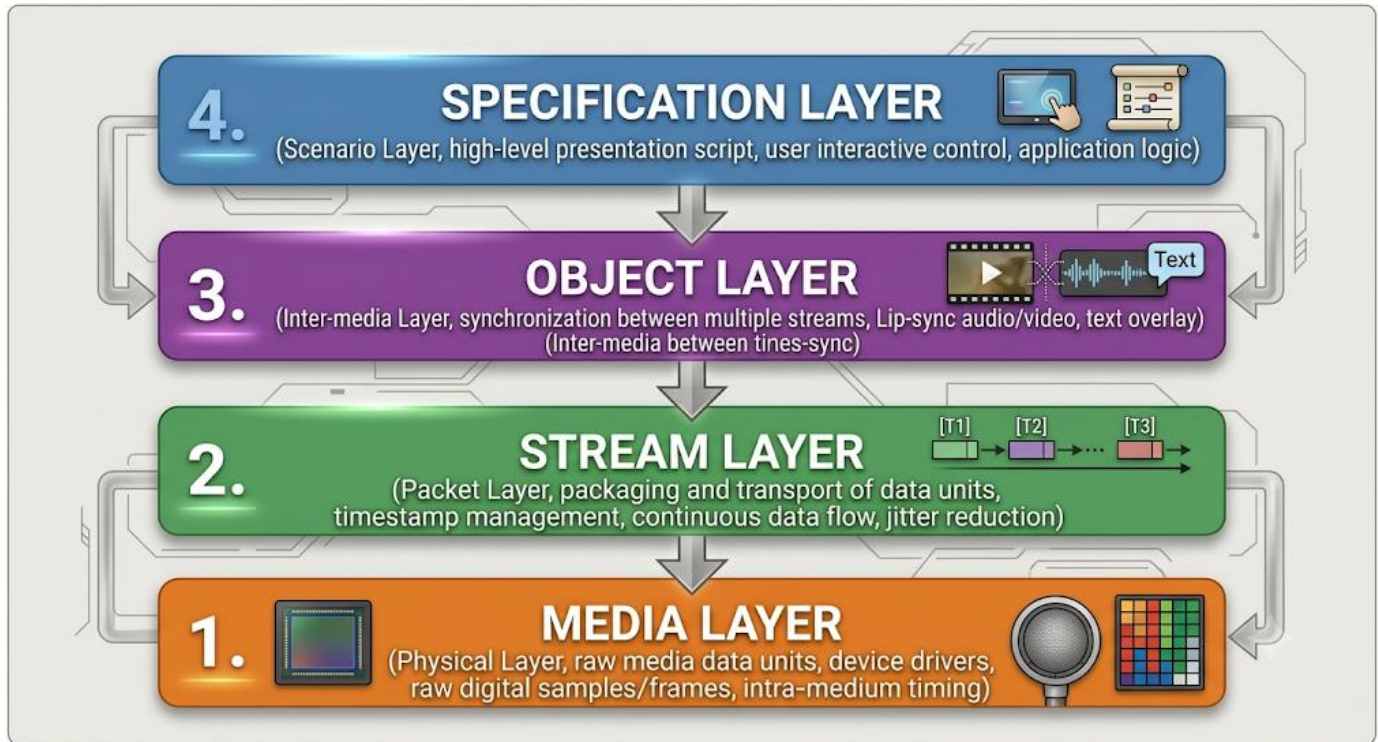
- **Definition:** ISO standard (ISO 8879) for defining generalized markup languages for documents.
- **Meta-Language:** It is not a markup language itself, but a **meta-language**—a system used to create and define other custom markup languages.
- **Document Type Definition (DTD):** Requires a DTD to define the specific tags, attributes, and structural rules allowed in a document.
- **Characteristics:** Extremely flexible, complex, and extensible. It allows custom tag creation for domain-specific documentation (e.g., aerospace, publishing).

HyperText Markup Language (HTML)

- **Definition:** The standard markup language designed specifically for structuring and presenting content on the Web.
- **An Application of SGML:** HTML (specifically versions HTML 1.0 through HTML 4.01) was originally created as a specific **application** (an instance) of SGML.
- **Predefined Tags:** Unlike SGML, HTML comes with a fixed, predefined set of tags (e.g., <h1>, <p>, <a>, <div>) that web browsers recognize and render.
- **Hyperlinks & Multimedia:** Designed specifically to support hyperlinks (connecting documents across networks) and multimedia elements.

Q.8. Explain briefly about model for multimedia synchronization. [10]

Synchronization in multimedia refers to maintaining the correct timing relationship between different media elements (e.g., keeping audio and video in sync) during storage, transmission and playback. A commonly used reference model describes synchronization at four different layers, from the raw media data up to the high-level presentation script:



- **Media Layer:** Controls raw, single-stream data and frame/sample playback rates.
- **Stream Layer:** Packages media into timestamped packets for jitter-free, continuous flow.
- **Object Layer:** Synchronizes multiple streams together (e.g., audio/video lip-sync).
- **Specification Layer:** Manages high-level presentation scripts and interactive scenarios.

Q.9. Write short notes on: (Any Two) [2×5 = 10]

a. Trends in Multimedia

Multimedia technology is continuously evolving, with several important trends visible today. Mobile multimedia has grown rapidly, with smartphones and tablets used to create, view and share multimedia content anywhere. Streaming media has replaced traditional download-based access, allowing instant playback of audio/video over the Internet through platforms such as YouTube and Netflix. Virtual Reality (VR) and Augmented Reality (AR) are increasingly used in gaming, training,

b. System Software

System software is a category of software that manages and controls the computer hardware and provides a platform/environment on which application software (including multimedia applications) can run. Unlike application software, which performs specific user tasks, system software works in the background to manage the resources of the computer. Examples of system software include the Operating System (e.g., Windows, macOS, Linux),

c. Designing Multimedia

Designing multimedia refers to the process of planning and structuring how different media elements (text, graphics, audio, video, animation) and interactive features of a multimedia application will be organized, presented, and linked together to effectively communicate information and provide a good user experience. The design process typically involves defining the target audience and objective, creating a storyboard/flowchart to plan the structure and navigation,



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Q.1. What is multimedia? Explain properties of multimedia system. [5 + 5]

Multimedia (5 marks)

Multimedia is the combination of more than one media element - such as text, graphics, audio, video and animation - integrated together with the help of a computer to create, store, present, and communicate information in an interactive and effective way. The term “multi” means many, and “media” refers to the means through which information is conveyed; hence multimedia literally means using many different means of communication together.

Properties of Multimedia System .

- **1. Combination of Media:** A multimedia system supports at least one continuous, time-based medium (audio/video) and one discrete, time-independent medium (text/image).
- **2. Integration:** Multiple media elements are combined together into a single, unified presentation rather than existing as separate files.
- **3. Digital Representation:** All media elements are converted into and processed in digital (binary) form so that a computer can store and manipulate them.
- **4. Interactivity:** The user can control the flow, navigation and selection of content, rather than viewing it in a fixed, linear order.
- **5. Synchronization:** The system maintains proper timing relationships between different media, e.g., keeping audio and video in sync during playback.

Q.2. Explain concept of sound. Explain speech transmission in brief. [5 + 5]

Concept of Sound.

Sound is a form of energy produced by the vibration of an object, which travels through a medium (such as air, water or a solid) in the form of pressure waves, and is perceived by the human ear as audible sensation.:

- **1. Frequency:** The number of vibrations/cycles per second, measured in Hertz (Hz); frequency determines the pitch of the sound (high frequency = high pitch).
- **2. Amplitude:** The strength/height of the sound wave, which determines the loudness or volume of the sound.
- **3. Wavelength:** The distance between two successive points of the same phase in a sound wave.

- **4. Timbre:** The quality/character of a sound that allows us to distinguish between two sounds of the same pitch and loudness but from different sources (e.g., a guitar vs a piano playing the same note).

Explain speech transmission in brief.

Speech transmission is the process of sending speech/voice data from a sender to a receiver over a communication channel or network, such as in telephone calls or Voice over IP (VoIP). It generally involves the following steps:

- **1. Capturing:** The speech signal is captured using a microphone, producing an analog electrical signal.
- **2. Digitization:** The analog speech signal is converted into digital form through sampling and quantization.
- **3. Compression/Encoding:** The digital speech data is compressed using a speech codec to reduce the amount of data to be transmitted.
- **4. Transmission:** The compressed speech data is transmitted over a network (telephone line, the Internet) using appropriate communication protocols.
- **5. Decoding and Playback:** At the receiving end, the data is decompressed, converted back into an analog signal (using a DAC), and played through a speaker.

Q.3. How digital image is represented? Explain about image analysis and transmission. [4]

A digital image is represented as a two-dimensional matrix/grid of small picture elements called pixels, where each pixel holds a numeric value representing its color/intensity.

- **1. Resolution:** The number of pixels in the image, expressed as width x height; higher resolution gives more detail.
- **2. Bit Depth/Color Depth:** The number of bits used to represent the color of each pixel (e.g., 24-bit RGB color); higher bit depth allows more colors to be represented.
- **3. Color Model:** Pixel color values are represented using a color model such as RGB for screens or CMYK for print.

Image Analysis (3 marks)

Image analysis is the process of extracting meaningful information, features, or patterns from a digital image using computer techniques. It includes operations such as image enhancement (improving visual quality), edge detection (identifying object boundaries), segmentation (dividing the image into meaningful regions),

Image Transmission (3 marks)

Image transmission is the process of sending image data from one location/device to another over a network. Since images can be large in size, transmission generally involves compression (e.g., JPEG, PNG)

Q.4. Define computer based animation. Explain methods of controlling animation. [2 + 8]

Computer-based animation refers to the technique of using computer software to create a sequence of images/frames that are displayed rapidly one after another to produce the illusion of motion, instead of drawing each frame manually as in traditional animation.

Methods of Controlling Animation

- **1. Keyframing:** The animator specifies important frames (keyframes) at specific points, and the software automatically generates the in-between frames (tweening).
- **2. Procedural Animation:** Animation is generated automatically using mathematical rules/algorithms rather than manually setting each frame, e.g., simulating water or fire.
- **3. Motion Capture:** The movement of real actors/objects is recorded using sensors/cameras and mapped onto a computer-generated character.
- **4. Kinematics:** Forward kinematics calculates the position of the end of a jointed structure from the movement of each joint in order, while inverse kinematics lets the animator move the end point directly and the software calculates the required joint positions.
- **5. Scripting/Animation Languages:** Animation behavior is controlled using scripting languages (e.g., Lingo, ActionScript, MEL) that define how objects move and respond to events.
- **6. Physics-Based Animation:** Animation is controlled by simulating real-world physical laws such as gravity and collision, producing natural motion automatically.
- **7. Morphing:** One shape/image is gradually transformed into another over a sequence of frames.

Q.5. What is data compression? Why we need it? Explain about lossy compression

Data Compression and its Need .

Data compression is the process of reducing the size of a file/data by encoding it using fewer bits than its original representation, so that it requires less storage space and can be transmitted faster over a network.

Data compression is needed because:

- **1. Large File Sizes:** Multimedia files (audio, image, video) are usually very large in their raw/uncompressed form, requiring huge storage space.
- **2. Limited Bandwidth:** Networks have limited bandwidth, so large uncompressed files would take a very long time to transmit or stream.
- **3. Cost Efficiency:** Compression reduces the storage and transmission cost by allowing more data to be stored/sent using less space and time.
- **4. Practical Streaming:** Compression makes it possible to stream audio/video smoothly over the Internet even with limited bandwidth.

Explain about lossy compression

Lossy compression is a compression method in which some data is permanently removed/discarded to achieve a much higher compression ratio; the original file cannot be exactly recovered after decompression, although the loss is often not very noticeable to the human eye or ear.

- **High compression ratio** — unnecessary/less-important data is removed, so file size becomes much smaller
- **Quality loss** — original file loses a bit of quality, but human eyes/ears usually don't notice it much
- **Based on human perception** — data that human senses (eye/ear) can't easily perceive is removed
- **Use case** — where file size matters a lot and slight quality loss is acceptable (streaming, web images)

Examples:

- **JPEG** — for images
- **MP3** — for audio
- **MPEG** — for video

Advantages & Disadvantages

- **Advantages:** Exceptionally small file sizes, fast network transmission speeds, and reduced storage and bandwidth costs.
- **Disadvantages:** Irreversible degradation of quality, and repeated saving/re-encoding leads to accumulated visual/audio distortion (generation loss)

Q.6. Explain development phase of multimedia. [10]

The development of a multimedia application/project is a systematic process that is generally carried out in the following phases



Analysis and Planning

Defining goals, estimating the budget/timeline, and creating a proposal.

Design

Structuring/planning content flow, sketching storyboards, and organizing text, audio, video, and graphics.

Development (Implementation)

Gathering media assets, building the application using authoring tools, and refining/editing elements. This is the most time-consuming phase.

Testing and Evaluation

Debugging the software, collecting user reviews, and fixing errors.

Publishing (Delivery)

Packaging the final product, launching it, and providing ongoing maintenance and support.

Q.7. Explain about quality of service. Explain about document architecture SGML. [5 + 5]

Quality of Service - QoS .

Quality of Service (QoS) refers to the set of performance parameters and mechanisms used to guarantee a required level of performance for the transmission of multimedia data over a network, especially for real-time applications

1. Bandwidth

The capacity to transmit data per unit time; multimedia requires sufficient guaranteed bandwidth for smooth playback.

2. Latency/Delay

The time taken for data to travel from sender to receiver; high delay causes lag in real-time apps (video calls).

3. Jitter

The variation in delay between consecutive packets; if uncontrolled, it makes audio/video choppy or uneven.

4. Packet Loss/Error Rate

The percentage of data lost or corrupted during transmission; this causes glitches or missing frames.

Document Architecture - SGML (5 marks)

SGML (Standard Generalized Markup Language) is a meta-language, i.e., a language used to define other markup languages, standardized by ISO. Rather than providing a fixed set of tags, SGML provides a general framework of rules (a Document Type Definition, or DTD) .

Key point

- Meta-language hai document structure define karne ke liye
- DTD se rules/structure set hota hai
- Content aur formatting alag-alag rakhta hai (platform-independent)
- Tags se content ko logically markup kiya jata hai
- HTML aur XML dono SGML se derive hue hain

Q.8. What is user interface? Explain about user friendliness as the primary goal in user interface.

A user interface (UI) is the means by which a user interacts with a computer system or application, including the visual elements (menus, buttons, icons, windows) and the way the user provides input (mouse, keyboard, touch, voice) and receives output (display, sound),

User Friendliness as the Primary Goal.

User friendliness refers to designing a user interface that is easy to learn, easy to use, and pleasant for the user to interact with. It is considered the primary goal of user interface design because even a technically powerful application will fail if users find it difficult, confusing, or frustrating to use. Important aspects of user friendliness include:

1. Easy to Learn

A new user should be able to understand and start using it quickly, without much training.

2. Efficient

Experienced users should be able to perform tasks quickly — with shortcuts and a smooth workflow.

3. Consistency

Same actions, icons, and layout should stay consistent everywhere, so what's learned on one screen applies to another.

4. Clear Feedback

Whatever action a user takes, the system should give an immediate, clear response (so they know their input was accepted or not).

5. Error Prevention & Recovery

Errors should be minimized, and if a mistake does happen, it should be easy to undo/fix.

6. Simplicity

The interface should stay simple — showing only necessary info and controls, without extra complexity.

Q.9. What is higher programming language? What is toolkits? [5 + 5]

Higher (High-Level) Programming Language (5 marks)

A higher/high-level programming language is a programming language that is designed to be easily read, written and understood by humans, using instructions that are close to natural (English-like) language rather than machine-level binary code.

Examples include C, C++, Java, Python and BASIC.

Key characteristics of a high-level language include:

- **1. Readability:** Code is written using words and syntax similar to human language, making it easier to write, read and debug.
- **2. Platform Independence:** Many high-level languages can run on different types of computers/operating systems with little or no modification.
- **3. Ease of Development:** Provides built-in functions, libraries and structured programming features that simplify software development.
- **4. Abstraction from Hardware:** The programmer does not need to know the internal hardware details (registers, memory addresses) of the computer, unlike low-level/assembly languages.

Toolkits (5 marks)

A toolkit is a collection of pre-built software components, functions, libraries and utilities that provide ready-made building blocks (such as buttons, media players, animation controls, and communication modules) for developing an application, without requiring the developer to write every function from scratch. Toolkits simplify and speed up the process of software/multimedia application development by allowing designers and programmers to reuse existing, tested components for common tasks such as playing audio/video, handling user interaction, or displaying graphics. Examples of multimedia toolkits/authoring environments include Macromedia/Adobe Director, Authorware, and various programming libraries/APIs.

Q.10. Write short notes on: [2×5]

a. MHEG

MHEG (Multimedia and Hypermedia Experts Group) is an ISO/IEC standard that defines a format for representing and encoding multimedia and hypermedia information, so that it can be exchanged and presented consistently across different hardware and software platforms. MHEG defines multimedia content as a collection of standardized objects (such as text, image, audio, video, and interaction objects) along with information about how these objects should be presented,

b. System Software

System software is a category of software that manages and controls the computer hardware and provides a platform/environment on which application software (including multimedia applications) can run. Unlike application software, which performs specific tasks for the user, system software works in the background to manage the resources of the computer. Examples of system software include the Operating System (e.g., Windows, macOS, Linux),

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Q.1. What is multimedia? Classify different types of medium. [2 + 8]

Multimedia (2 marks)

Multimedia is the combination of more than one media element - such as text, graphics, audio, video and animation - integrated together with the help of a computer to create, store, present, and communicate information in an interactive and effective way.

Classification of Medium (8 marks)

In the context of multimedia systems, a “medium” is a means through which information is represented, stored, transmitted or presented. Different types of medium can be classified as follows:

1. Perception Medium

How humans perceive information using their senses — like seeing (visual) or hearing (audio). E.g., seeing an image with the eye, hearing a sound with the ear.

2. Representation Medium

The format used to encode information inside a computer — like ASCII text, bitmap image, MPEG video.

3. Presentation Medium

The hardware that outputs/inputs information — output: monitor, speaker, printer; input: keyboard, mouse, microphone.

4. Storage Medium

The physical medium used to store digital data — like a hard disk, CD/DVD, pen drive.

5. Transmission Medium

The medium used to transmit data from one place to another — like a telephone line, optical fibre, coaxial cable.

6. Information Exchange Medium

Combines storage and transmission to carry information between systems — like a network or a removable storage device.

Q.2. Explain different attributes of sound waves in brief. Also describe MIDI basic Concept. [5 + 5]

Attributes of Sound Waves (5)

- **1. Frequency:** The number of vibrations/cycles of the sound wave per second, measured in Hertz (Hz); frequency determines the pitch of the sound - higher frequency means higher pitch.
- **2. Amplitude:** The height/strength of the sound wave, which determines the loudness or volume of the sound - greater amplitude means louder sound.
- **3. Wavelength:** The distance between two successive points of the same phase (e.g., crest to crest) in a sound wave.
- **4. Timbre (Waveform):** The quality or character of a sound that allows us to distinguish between two sounds of the same pitch and loudness but produced by different sources, e.g., a guitar and a piano playing the same note.
- **5. Velocity/Speed:** The speed at which the sound wave travels through a medium, which depends on the properties of the medium (e.g., sound travels faster through water than through air).

MIDI - Basic Concept (5 marks)

MIDI (Musical Instrument Digital Interface) is a standard protocol that allows electronic musical instruments, computers, and synthesizers to communicate with each other.

Key points:

- **Doesn't transmit actual sound** — only sends instructions/commands (like "note ON", "note OFF", "volume", "pitch")
- **Compact and small size** — since it stores/transmits commands, not audio data
- **Editable** — notes, tempo, and instrument can be easily changed without re-recording

Simple example: When you press a key on a keyboard, MIDI just sends "note X pressed, at this volume" — the actual sound is generated by the receiving device (synthesizer/computer).

.Q.3. What is an image? List the different file format of image. Differentiate between vector and raster graphics. [2 + 2 + 6]

Image

An image is a visual representation of an object, scene, or information, which can be captured (using a camera/scanner) or created (using software) and stored digitally as a two-dimensional arrangement of pixels or as a set of mathematical shapes/paths.

Image File Formats (2 marks)

- JPEG/JPG - Joint Photographic Experts Group
- PNG - Portable Network Graphics
- GIF - Graphics Interchange Format
- BMP - Bitmap Image File
- TIFF - Tagged Image File Format
- SVG - Scalable Vector Graphics

Vector vs Raster Graphics (6 marks)

Basis	Raster (Bitmap) Graphics	Vector Graphics
Composition	Made up of a grid of pixels (dots).	Made up of mathematical paths, lines and curves.
Scaling	Loses quality/becomes blurred when enlarged.	Can be scaled to any size without losing quality.
File Size	Usually large, depends on resolution.	Usually small, independent of size.
Suitable For	Photographs and realistic images.	Logos, icons and line-based illustrations.
Example	A digital photograph saved as .jpg or .png.	A company logo designed in CorelDRAW/.svg format.

Q.4. Differentiate between video and animation. Explain different stages of computer based animation. [4 + 6]

Video vs Animation

Aspect	Video	Animation
Definition	A sequence of real, captured images (frames) shown quickly to show motion	A sequence of artificially created/drawn images shown quickly to create the illusion of motion
Source	Recorded using a camera from real-world scenes/people	Created manually or digitally (hand-drawn, computer-generated, clay models, etc.)
Content type	Real, live-action footage	Artificial/imaginary content — characters, objects, effects that may not exist in real life
Creation method	Captured directly through recording equipment	Built frame-by-frame using drawing, modeling, or software tools
Flexibility	Limited — depends on real actors, locations, and physical constraints	High — anything can be created, including impossible scenes/characters
Examples	Movies, news footage, video calls, recorded lectures	Cartoons, 3D animated movies, motion graphics, game characters

Stages of Computer Based Animation.

- **1. Concept/Story Development:** Deciding the idea, theme, and storyline of the animation.
- **2. Storyboarding:** Creating a sequence of rough sketches/frames that outline the key scenes, camera angles and action of the animation.
- **3. Modeling:** Creating the 2D/3D shapes, characters and objects that will appear in the animation.
- **4. Keyframing:** Defining the important frames (keyframes) at specific points that mark major changes in position or shape of an object.
- **5. In-betweening/Tweening:** Generating the intermediate frames between keyframes, either manually or automatically by software, to create smooth motion.
- **6. Rendering:** Converting the modeled scene, including lighting, texture and shading, into the final sequence of images/frames.

Q.5. What do you mean by data compression? Differentiate between lossless compression method and lossy compression method.

Data Compression .

Data compression is the process of reducing the size of a file/data by encoding it using fewer bits than its original representation, so that it requires less storage space and can be transmitted faster over a network.

Differentiate between lossless compression method and lossy compression method.

Basis	Lossless Compression	Lossy Compression
Meaning	No data is lost; the original data can be exactly reconstructed.	Some data is permanently lost/removed to achieve higher compression.
Quality	Original quality is fully preserved.	Some loss of quality occurs, though often not very noticeable.
Compression Ratio	Lower compression ratio (less size reduction).	Higher compression ratio (greater size reduction).
Reversibility	Fully reversible - exact original file can be recovered.	Not reversible - original file cannot be exactly recovered.
Usage	Used where exact data is essential, e.g., text, program files, medical images.	Used where minor quality loss is acceptable, e.g., photos, audio, video.
Example Formats	ZIP, PNG, GIF, FLAC	JPEG, MP3, MPEG

Q.6. Explain the importance of Hypermedia database in modern application. Explain different types of multimedia database. [5 + 5]

Importance of Hypermedia Database in Modern Applications (5 marks)

A hypermedia database is a database that stores multimedia content (text, image, audio, video) along with links/associations between different pieces of content, allowing non-linear navigation. Its importance in modern applications includes:

- **1. Efficient Content Organization:** Allows large volumes of multimedia content to be stored, organized and linked in a structured, retrievable way.
- **2. Content-Based Retrieval:** Supports searching and retrieving multimedia data based on actual content (color, shape, keywords) rather than just filenames.
- **3. Enhanced User Navigation:** Enables non-linear browsing between related pieces of information, as used in websites, digital libraries and e-learning systems.
- **4. Supports Rich Applications:** Forms the backbone of modern applications such as digital libraries, e-learning platforms, video-on-demand systems, and content management systems.
- **5. Scalability:** Provides a structured way to manage the growing volume of multimedia data generated and consumed today.

Types of Multimedia Database (5 marks)

- **1. Text Database:** Stores and manages textual documents and allows keyword/text-based search and retrieval.
- **2. Image Database:** Stores images along with metadata/features, allowing search and retrieval based on visual content (color, shape, texture).
- **3. Audio Database:** Stores audio files and allows retrieval based on audio features such as pitch, tone, or a sample clip.
- **4. Video Database:** Stores video files and supports retrieval based on scenes, objects, or content within the video.
- **5. Hypermedia/Object-Oriented Database:** Stores multiple types of media together with links and relationships between them, supporting complex, non-linear multimedia applications.

PUBLISHER

Q.7. Explain user Interface. Explain general design issues in multimedia in brief. [4 + 6]

User Interface (4 marks)

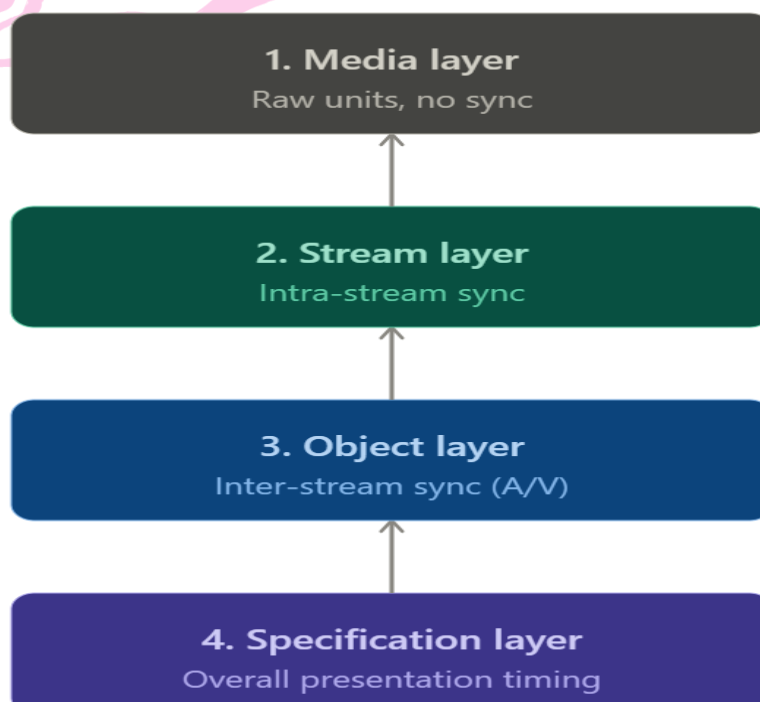
A user interface (UI) is the means by which a user interacts with a computer system or application, including the visual elements (menus, buttons, icons, windows) and the way the user provides input (mouse, keyboard, touch, voice) and receives output (display, sound)

General Design Issues in Multimedia.

- **1. Consistency:** Maintaining a consistent layout, color scheme, fonts and navigation style throughout the application.
- **2. Navigation:** Designing a clear and intuitive navigation structure so that users can easily move through the content without getting lost.
- **3. Media Selection and Balance:** Choosing the right combination of media elements (text, graphics, audio, video, animation) so that they support the content without overwhelming the user.
- **4. Interface/Screen Design:** Designing a clear, uncluttered, and visually appealing screen layout with proper use of white space, color and typography.
- **5. File Size and Bandwidth:** Considering the size of multimedia files and available bandwidth so that the application loads and plays smoothly for the target users.
- **6. Compatibility:** Ensuring the application works correctly across different hardware, operating systems, browsers and screen sizes.

Q.8. Describe about the four-layer synchronization reference model. [10]

Synchronization in multimedia refers to maintaining the correct timing relationship between different media elements (e.g., keeping audio and video in sync) during storage, transmission and playback.



1. Media Layer

The lowest layer, dealing with raw individual media units — like a single video frame or audio sample. No synchronization happens here yet; it just handles the basic captured data.

2. Stream Layer

Groups individual media units into a continuous stream (e.g., frames into a video stream). Handles **intra-stream sync** — making sure units within one stream play in correct order and at the correct rate.

3. Object Layer

Combines multiple related streams into one logical multimedia object. Handles **inter-stream sync** — like syncing audio with video (lip-sync) or subtitles with video.

4. Specification Layer

The highest layer, defining the overall **timing and structure** of the full presentation — when each media object starts/stops and how objects relate across the entire timeline..

Q.9. Write short notes on: (Any Two) [2×5 = 10]

a. Trends in Multimedia Application

Multimedia technology is continuously evolving, with several important trends visible today. Mobile multimedia has grown rapidly, with smartphones and tablets used to create, view and share multimedia content anywhere. Streaming media has replaced traditional download-based access, allowing instant playback of audio/video over the Internet through platforms such as YouTube and Netflix.

b. Image Synthesis

Image synthesis is the process of artificially generating a new image using a computer, based on mathematical models, algorithms and rules, rather than capturing it directly from the real world with a camera or scanner. It is a core technique in computer graphics used to create realistic or stylized visuals. Image synthesis typically involves modeling (creating a geometric/mathematical description of the objects/scene),

c. Toolkits

A multimedia toolkit is a collection of pre-built software components, functions, libraries and utilities that provide ready-made building blocks (such as buttons, media players, animation controls, and communication modules) for developing multimedia applications, without requiring the developer to write every function from scratch. Toolkits simplify and speed up the process of multimedia application development by allowing

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Q.1. Explain the properties of multimedia system according to variation of consecutive packet amount. Also discuss on information units. [5 + 5]

Properties Based on Packet Variation (5 marks)

A multimedia system deals with continuous, time-dependent media (audio, video) transmitted as a stream of data packets. Based on the time relationship / variation between consecutive packets, transmission can be classified into three categories:

- **1. Asynchronous transmission mode:** There is no fixed time relationship between consecutive data packets. Packets are transmitted and processed as soon as possible, but no upper or lower bound on delay is guaranteed. Suitable for discrete media such as text and simple data files.
- **2. Synchronous transmission mode:** A maximum end-to-end delay (upper bound) is defined for delivery, but data may arrive earlier than this bound. There is no minimum delay guarantee. Used where an upper time limit must not be exceeded, e.g. monitoring/alarm systems.

An information unit is the smallest meaningful, self-contained piece of data used to represent, store, transmit or measure information in a multimedia system. Multimedia data is organized in a hierarchy of such units:

- **1. Bit:** The smallest unit of digital information (0 or 1).
- **2. Byte/Word:** A group of bits (commonly 8 bits = 1 byte) used to represent a character or small value.
- **3. Element/Sample:** The basic unit of a particular medium, e.g. a pixel for an image, a sample for audio, a frame for video.
- **4. Object:** A logically related collection of elements, e.g. an icon, a video clip or an audio clip, treated as a single manageable unit.

Q.2. Explain speech generation. How does sound be represented digitally? Explain.

Speech Generation (6 marks)

Speech generation (speech synthesis) is the artificial production of human speech by a computer system, commonly known as Text-to-Speech (TTS) conversion. It converts written text into intelligible, natural-sounding spoken output through the following stages:

- **1. Text analysis:** Expands abbreviations, numbers and symbols into full words, and identifies sentence/phrase boundaries.
- **2. Linguistic analysis:** Determines grammatical structure, word stress and intonation so the speech sounds natural.

- **3. Waveform generation:** Converts the phoneme and prosody information into an actual audio waveform, using techniques such as:
 - **Articulatory synthesis** – models the physical behaviour of the human vocal tract.
 - **Formant synthesis** – generates speech using rules controlling acoustic parameters.
 - **Concatenative synthesis** – builds speech by joining pre-recorded human speech segments.

Digital Representation of Sound (4 marks)

- **1. Sampling:** The analog signal is measured at regular time intervals; the number of samples per second is the sampling rate (e.g. 44.1 kHz for CD audio). By the Nyquist theorem, the sampling rate must be at least twice the highest frequency present to avoid distortion.
- **2. Quantization:** Each sampled amplitude value is rounded to the nearest of a finite set of discrete levels, determined by the bit depth (e.g. 16-bit gives 65,536 levels). Higher bit depth means finer resolution and less noise.
- **3. Encoding:** The quantized values are converted into a binary code, typically Pulse Code Modulation (PCM), for storage or transmission, and can later be compressed (e.g. MP3, AAC).

Overall data rate = Sampling rate × Bit depth × Number of channels (mono/stereo).

Q.3. What is image? Differentiate between vector and raster image with examples [2 + 2]

An image is a visual representation of an object, scene or concept, captured or created in two-dimensional form. A digital image is a numeric representation of visual data, made up of pixels or geometric/mathematical descriptions, that can be stored, processed and displayed by a computer.

Vector vs Raster Image (2 + 4 marks)

Raster (Bitmap) Image	Vector Image
Made up of a grid of pixels, each with a colour value.	Made up of mathematical objects — points, lines, curves, polygons.
Loses quality/becomes blurred when enlarged.	Can be scaled to any size without loss of quality.
Generally larger, depends on resolution.	Generally smaller, depends on complexity of shapes.
Difficult to edit individual objects; edited pixel by pixel.	Easy to edit individual objects independently.
BMP, JPEG, PNG, GIF, TIFF	SVG, AI, EPS, CDR
Photographs and images with complex tones.	Logos, icons, illustrations and line art.
A digital photograph opened in Photoshop.	A company logo designed in Illustrator/CorelDRAW.

What do you mean by computer based animation? Explain. Also discuss on animation language. [7+3]

Computer Based Animation (7 marks)

Computer-based animation is the technique of creating the illusion of movement or change of an object/scene by displaying a rapid sequence of computer-generated still images (frames), each slightly different from the previous one. Due to the persistence of human vision, frames displayed fast enough (24–30 fps) are perceived as continuous motion.

- The animator defines key positions of an object, called key frames, at important points in time.
- The computer automatically generates the in-between frames (tweening/interpolation) for smooth transition.

Types of computer animation:

- **1. 2D animation:** Objects animated in a two-dimensional (x, y) space, e.g. traditional cartoons.
- **2. 3D animation:** Objects modelled in three-dimensional (x, y, z) space, giving depth and realism.
- **3. Path/motion animation:** An object is moved along a predefined path or trajectory.
- **4. Morphing:** One image/shape is gradually transformed into another.

Animation Language (3 marks)

An animation language is a specialized, often script-based, language/system that allows an animator to describe objects, their properties, motion and timing, instead of writing raw graphics code. Animation languages are broadly grouped into:

- **1. Linear list / keyframe systems:** The animator specifies a sequence of key frames with timing, and the system interpolates in-between frames.
- **2. General purpose / scene description languages:** Provide full procedural control over graphics, motion and interaction, allowing conditional logic and interactivity, e.g. Macromedia Director's Lingo.

Q.5. What is data compression? Why do we need data compression? Explain about entropy and hybrid coding. [2 + 2 + 6]

Data Compression (2 marks)

Data compression is the process of reducing the size (number of bits) of data by encoding it more efficiently, so it occupies less storage space and requires less bandwidth for transmission, while allowing the original data to be reconstructed when required.

Why We Need Data Compression (2 marks)

- Multimedia data (audio, image, video) is naturally very large; compression reduces storage cost.
- It reduces transmission time and required bandwidth, enabling faster, smoother streaming.
- It makes real-time transmission (e.g. video conferencing) practically possible.
- It allows more data to be stored on the same storage device.

Entropy Coding and Hybrid Coding (6 marks)

Entropy coding is a lossless compression technique that encodes data based on the statistical frequency of occurrence of symbols, without any loss of information.. It is based on Shannon's concept of entropy

- **Run-Length Encoding (RLE)** – replaces consecutive repeated symbols with a single symbol and a count.
- **Huffman coding** – builds a variable-length prefix code based on symbol probabilities.
- **Arithmetic coding** – represents the entire message as a single fractional number based on cumulative probabilities.

Hybrid coding combines two or more different compression techniques — typically a lossy transform/quantization stage followed by a lossless entropy coding stage — to achieve a higher overall compression ratio while keeping acceptable quality. For example, in JPEG and MPEG compression,

.6. What are the basic design issues of user interface? How can we get user friendliness in user interface? [4 + 6]

Basic Design Issues of User Interface (4 marks)

- **1. Consistency:** Similar operations and elements should behave and look the same throughout.
- **2. Ease of learning and use:** The interface should be simple to learn and efficient to use thereafter.
- **3. Feedback:** The system should give the user timely, clear feedback for every action.
- **4. Error handling and prevention:** The design should minimize user errors and give clear error messages.

Achieving User-Friendliness (6 marks)

- **1. Simplicity and clarity:** Keep the layout clean, use clear labels/icons, and avoid clutter.
- **2. Consistent design:** Use uniform colours, fonts, icons and navigation across all screens.
- **3. Intuitive navigation:** Provide a logical, easy-to-follow menu/navigation structure.
- **4. Meaningful feedback:** Confirm every user action with visible messages or progress indicators.
- **5. Helpful error messages and undo:** Explain errors in plain language and allow undo/redo.
- **6. Accessibility and help:** Ensure good contrast, readable fonts, keyboard navigation, and easy access to help/documentation.

8. Explain briefly about application subsystem and multimedia database management system. [10]

9. Application Subsystem (5 marks)

The application subsystem is the topmost layer of a multimedia system architecture, consisting of the actual multimedia application programs (e.g. video conferencing tools, e-learning software, authoring tools) through which end-users interact with multimedia data. It is responsible for:

- Providing the user interface through which multimedia content is created, edited and presented.
- Interpreting user requests and translating them into calls to underlying system services.
- Coordinating different media and ensuring correct presentation (e.g. lip-sync in a video call).
- Tying together lower-level services (OS, networking, database) into a usable, task-oriented tool.

Multimedia Database Management System (5 marks)

A Multimedia Database Management System (MMDBMS) is a software system that manages a database of multimedia objects (text, image, audio, video, animation), providing facilities to efficiently store, index, retrieve, query and update large volumes of heterogeneous media data. Key features include:

- **Storage management** – efficiently stores large, variable-sized multimedia objects.
- **Content-based retrieval** – allows searching based on actual media content (colour, shape, texture), not just metadata.
- **Specialized indexing** – uses multi-dimensional/feature-based indexing for fast similarity retrieval.
- **Synchronization support** – maintains temporal relationships among related media objects.

Q.8. What is HTML? Why does HTML know as markup language? Write short notes on document architecture. [3 + 3 + 4]

HTML (HyperText Markup Language) is the standard language used to create and structure content on the World Wide Web. It uses tags/elements to define parts of a web document — headings, paragraphs, links, images, tables, forms — which a browser interprets and renders as a formatted web page.

HTML as a Markup Language (3 marks)

HTML is called a markup language because it does not perform computation or logic like a programming language; instead it "marks up" plain text with tags that describe the structure/meaning of the content, telling the browser how to display it.

Document Architecture (4 marks)

Document architecture is the standardized, logical structure used to represent an electronic document so that its content, layout and presentation can be exchanged and processed consistently across systems. It is generally viewed at two levels:

- **1. Logical (generic) structure:** Describes the document in terms of logical components — title, sections, paragraphs — independent of final presentation.
- **2. Layout (presentation) structure:** Describes how components are formatted and positioned — page size, fonts, margins, layout.

A well-known standard is ODA (Open Document Architecture), which allows documents to be exchanged between systems while preserving both logical and layout structure. On the Web, HTML defines the logical structure while CSS defines layout/presentation, keeping content and presentation separate.

Q.9. Discuss on model for multimedia synchronization. [10]

Multimedia synchronization is the process of maintaining correct temporal and spatial relationships among different media objects (e.g. audio and video) so they are presented together as intended, e.g. lip-sync between speech and video. Several models are used to specify these requirements:

- **1. Interval-based model (Allen's interval algebra):** Each media object is a time interval; relationships between two intervals (before, meets, overlaps, during, starts, finishes, equal) express all possible temporal relations.
- **2. Axes-based (timeline) model:** A single common timeline is used and each media object is anchored on it according to its intended start time and duration. Simple and used in most authoring tools.
- **3. Reference point (event-based) model:** Synchronization is expressed via discrete events/reference points within a media stream, which trigger actions in another stream — well suited for interactive presentations.
- **4. Hierarchical (structure-based) model:** The presentation is organized as a hierarchy of scenes and objects, with synchronization defined at each level and combined to satisfy higher-level timing requirements, e.g. as used in SMIL.

Q.10. Write short notes on (Any Two): [2 x 5]

Media Composition (5 marks)

Media composition is the process of combining and arranging multiple individual media objects (text, image, audio, video, animation) into a single, coherent multimedia presentation. It involves deciding what media to include and defining their spatial layout (where each object appears) and temporal layout (when/how long each is presented and how it is synchronized with others).

System Software (5 marks)

System software refers to programs that manage and control computer hardware and provide a platform on which application software (including multimedia applications) can run. In a multimedia system it includes the operating system, device drivers, and utilities providing:

- Process/memory management, including real-time scheduling for continuous media playback.
- Device management for multimedia I/O devices (sound cards, graphics cards, cameras, microphones).
- File system support for large multimedia files, and network support for streaming/conferencing.

Because continuous media need timely, predictable delivery, multimedia systems often require real-time operating systems or real-time extensions.

