Pokhara University

Faculty of Science and Technology

Course No.: CMP 333	Full marks: 100
Course title: Multimedia Systems (2-1-2)	Pass marks: 45
Nature of the course: Theory and Practical	Total Lectures: 30 hrs
Level: Bachelor	Program: BE (IT)

Authors

Dr. Udaya Raj Dhungana	9846025070
Er. Rishi Kanta Marseni	9846062807
Er. Bikash Bhattarai	9843368914

1. Course Description

This course introduces students to the key concepts and technologies behind multimedia, including sound, images, video, animations and data compression. Students will learn both the theory and practical skills needed to design and work with multimedia systems. Through a mix of lectures and hands-on labs, students will gain the ability to create and evaluate multimedia content, preparing you to apply these skills in real-world settings.

2. General Objectives

- Foundational understanding of multimedia systems.
- Development of technical proficiency in multimedia processing.
- Application of knowledge in designing multimedia components.
- Encouragement of critical thinking in multimedia evaluation.

3. Methods of Instruction

Lectures for theoretical foundation.

Discussion Sessions for interactive learning.

Hands-on **Practical Work** for applied skills.

Project-Based Learning for integrative experience.

Readings and **Assignments** for reinforcement and assessment.

4. Contents in Detail

Specific Objectives	Contents
Identify and describe the essential components of multimedia systems, including text, audio, images, and video, and understand their roles and interactions.	**1. Introduction to Multimedia(3 hrs)** 1.1. Overview of Multimedia, Building Blocks of multimedia 1.1.1. The Medium aspects, Application areas and usefulness,Properties of multimedia 1.1.2. Global Structure of Multimedia 1.1.3. Data Stream Characteristics: Asynchronous and Synchronous Transmission Mode
Describe how sound and music are represented in digital systems, including concepts of sampling, bit depth, and MIDI technology. Outline the basic concepts of image processing, including image synthesis, analysis, and enhancement techniques.	**2. Sound and Graphics (5 hrs)** 2.1. Basic Sound Concepts 2.1.1. Computer Representation of Sound/Audio 2.1.2. Computer Representation of Music: MIDI 2.1.3. MIDI Devices, MIDI Modes, MIDI Messages and MIDI Software. 2.2. Speech Concepts 2.2.1. Speech Processing and Speech Analysis 2.2.2. Speech Recognition 2.3. Image Definition: Basic Concepts 2.3.1. Image Processing Fundamentals(Image Synthesis,Image Analysis, Image Transmission) 2.3.2. Image Recognition Steps

	2.3.3. Image Enhancement Methods
Understand how video is represented and formatted, and explain the significance of different video formats and Compare and contrast computer-based animation, handwritten animation, and stop-motion animation, including their techniques and applications.	**3. Video and Animation Technology (3 hrs)** 3.1. Basic Video Concept: Representation and Format 3.2 Television: High Definition Television(HDTV) 3.3 Animation: Types of Animation 3.3.1 Computer Based Animation 3.3.2 Handwritten Animation 3.3.3 Stop Motion Animation 3.4 Design Principles of Animation, Methods of Controlling Animations

Explain the differences between lossy and lossless data compression methods, including examples and applications of each and describe the principles and applications of key data compression techniques such as Huffman coding and JPEG compression.	**4. Data Compression Methods(6 hrs)** 4.1. Coding Requirement 4.2. Types of Compression: Lossy and Lossless Compression 4.2.1. Run length Coding,Entropy Coding 4.2.2. Huffman Coding 4.2.3. Arithmetic Coding 4.3. Coding Standards 4.3.1. JPEG: JPEG compression steps 4.3.2. MPEG: Evolution of MPEG, Data Stream of MPEG,MPEG Audio 4.4. Digital Video Interactive (DVT), h.261(p✖64)
• Understand the fundamental principles of optical storage media, including CD DA and CD-ROM technologies, and their features.and Outline the various DVD formats and their uses, including differences from other optical storage media.	**5. Storage Media (3 hrs)** 5.1. Basic of Optical Storage Technology 5.1.1. Compact Disk Digital Audio (CD DA):Audio Data Rate,Capacity, Error handling, Eight to Fourteen Modulation 5.1.2. Compact Disk Read Only Memory(CD-ROM):Blocks,CD-ROM modes 5.1.3. CD-ROM Extended Architecture (CD-ROM/XA): Form 1 and Form 2 5.2. DVD, DVD Formats

Describe the principles of document architecture, focusing on SGML and ODA standards. and define hypertext and hypermedia, and understand the basic architecture and components of hypermedia systems, including nodes and pointers.	**6. Document Architecture,Hypertext and MHEG (4hrs)** 6.1. Documents, Document Architecture :SGML and ODA 6.2. Hypertext, Hypermedia and Multimedia 6.3. Hypermedia System: Architecture, Nodes and Pointers 6.4. Brief History of Hypertext and application areas of Hypertext. 6.5. MHEG: Class Hierarchy of MHEG objects, MHEG Identifier and MHEG Descriptor, Contents, Behaviour, Interaction,Container and Closing Comments.

Explain the concepts of real-time operating systems and resource management for multimedia applications, including scheduling methods like EDF and RMA. Outline the components and functions of multimedia communication systems, including session management and quality of service (QoS) principles	**7. Multimedia Operating System and Communication Systems (6 hrs)** 7.1. Introduction to MOS, Real Time Systems and Deadline 7.1.1. Resource Management: Resource and Requirements 7.1.2. Phases of Resource Reservation and Management Process, Allocation Scheme 7.1.3. Continuous Media Resource Model 7.1.4. Process Management, Real Time Processing Requirement, Traditional Real Time Scheduling(EDF and RMA) 7.2 Communication Architecture:Application Subsystem and Transport Subsystem 7.2.1 Session Management, Multimedia Workstation 7.2.2 Quality of Service and Resource Management, Design Principle of QoS.

5. Practical Works

Laboratory work of 30 hours per group of maximum 24 students should cover implementation of the following

SN	Implementation Description
1	Implementation of basic sound processing techniques, including audio synthesis and manipulation.
2	Development of a simple MIDI-based music creation tool that supports basic MIDI messages and device integration
3	Image processing fundamentals: Implementing techniques for image enhancement, including point processing and spatial filtering.
4	Video encoding and compression using basic standards such as JPEG and MPEG, focusing on practical application.
5	Creation of a basic animation sequence using keyframe animation, demonstrating principles of motion and timing.
6	Implementation of a simple multimedia application that integrates sound, image, and video elements.
7	Data compression techniques: Practical implementation of lossless compression methods such as Huffman coding.
8	Storage media exploration: Demonstration of DVD, HDD and SSD data storage and retrieval methods.
9	Design and development of a simple multimedia document using SGML or a similar markup language.
10	A final project that integrates various multimedia elements learned in the course, such as combining sound, image, and video into a cohesive system.

For the practical works, we may use several key Python libraries to manage different multimedia tasks. **NumPy** and **SciPy** will help us with the basics of scientific computing and image processing. **Pillow** and **OpenCV** will be our go-to for working with images and videos. To handle audio, use **PyDub** and **Librosa**, while **Matplotlib** will be handy for creating visualizations. **MoviePy** will make video editing straightforward, and **PyGame** will be great for building multimedia apps. We may use **SoundFile** for audio file handling, and **FFmpeg**

(with ffmpy) for advanced audio and video processing tasks. These tools will be essential as you dive into the practical side of multimedia systems.

Students should submit a project work that uses all the knowledge obtained from this course to solve any problem chosen by themselves. The marks for the practical evaluation must be based on the project work submitted by students.

6. List of Tutorials

The various tutorial activities that suit your course should cover all the content of the course to give students a space to engage more actively with the course content in the presence of the instructor. Students should submit tutorials as assignments or class works to the instructor for evaluation. The following tutorial activities of 15 hours per group of maximum 24 students should be conducted to cover the content of this course:

A. Discussion-based Tutorials: (3 hrs)

i. Discussion on the importance and applications of multimedia in modern technology.
(Class discussion)

ii. Analysis of different multimedia systems and their real-world use cases.
(Class discussion)

iii. Exploring the future trends (like metaverse) in multimedia technology.
(Class discussion)

B. Problem solving-based Tutorials: (6 hrs)

i. Design a system to encode and decode simple audio and video data.

ii. Design a system that implements basic image processing, such as filtering and enhancement.

iii. Suppose you are given a task to design a multimedia system for an educational platform—outline your approach.

C. Review and Question/Answer-based Tutorials: (6 hrs)

i. Case study on the history of multimedia technology and its evolution
(Oral Presentation in class).

ii. Case study on a multimedia system currently used in a specific industry (e.g., entertainment, education, or healthcare).

iii. Students ask questions within the course content, discuss assignments, and review key concepts in preparation for tests or exams.

7. Evaluation System and Students' Responsibilities

Evaluation System

The internal evaluation of a student may consist of assignments, attendance, internal assessment, lab reports, project works etc. The internal evaluation scheme for this course is as follows:

Internal Evaluation	**Weight**	**Marks**	**External Evaluation**	**Marks**
Theory		30	Semester-End examination	50
Attendance & Class Participation	10%			
Assignments	20%			
Presentations/Quizzes	10%			
Internal Assessment	60%			
Practical		20		
Attendance & Class Participation	10%			
Lab Report/Project Report	20%			
Practical Exam/Project Work	40%			
Viva	30%			
Total Internal		50		
Full Marks: 50 + 50 = 100				

Student Responsibilities

Each student must secure at least 45% marks separately in internal assessment and practical evaluation with 80% attendance in the class in order to appear in the Semester End Examination. Failing to get such a score will be given NOT QUALIFIED (NQ) to appear for the Semester-End Examinations. Students are advised to attend all the classes, formal exam, test, etc. and complete all the assignments within the specified time period. Students are required to complete all the requirements defined for the completion of the course.

8. Prescribed Books and References

Text Books

1. Steinmetz, R., Nahrstedt, K., "Multimedia Systems", Springer.

References Books

1. Halsall, F., "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson.
2. Parekh, R., "Principles of Multimedia", Tata McGraw-Hill.
3. Andleigh, P., Thakrar, K., "Multimedia Systems Design", Prentice Hall.