

**CARDIFF UNIVERSITY  
EXAMINATION PAPER**

**Academic Year:** 2006/2007  
**Examination Period:** Autumn  
**Examination Paper Number:** CM0340  
**Examination Paper Title:** Multimedia  
**Duration:** 2 hours

**Do not turn this page over until instructed to do so by the Senior Invigilator.**

**Structure of Examination Paper:**

There are 4 pages.

There are 4 questions in total.

There are no appendices.

The mark obtainable for a question or part of a question is shown in brackets alongside the question.

**Students to be provided with:**

The following items of stationery are to be provided:  
ONE answer book.

**Instructions to Students:**

Answer 3 questions.

The use of translation dictionaries between English or Welsh and a foreign language bearing an appropriate departmental stamp is permitted in this examination.

- Q1. (a) Why is *data compression* desirable for multimedia activities? [2]  
 (b) Briefly outline the **four** broad classes of approach that one may exploit to compress multimedia data. **Do not detail any specific compression algorithms.** [8]

Give one example of a compression algorithm for each class. [4]

- (c) Consider the following sequence of 8-bit integers:

4 6 9 11 13 12 13 14 12 11

Show how you would code this sequence using:

- i. Differential Pulse Code Modulation (DPCM). [3]
- ii. Differential Pulse Code Modulation with delta modulation. [3]
- iii. Adaptive Differential Pulse Code Modulation (ADPCM) with window size of 3. [4]

Comment on the relative efficiency of these methods on the above sequence. [3]

- Q2. (a) What is *MIDI*? [2]  
 (b) What *features* of MIDI make it suitable for *controlling* software or hardware devices? [6]  
 (c) Briefly outline how MIDI might be used to control to following:

- i. Musical *disco lights* that pulse different lights in time with some MIDI music. [3]
- ii. *Video DJing* where the playing and synchronisation of video and music clips is controlled via MIDI. [5]
- iii. A *motion capture MIDI interface* where musical information is input via arm and upper body motion or gestures. [5]
- iv. A *singing musical sampler/synthesiser* where the synthesiser can take in English phrases and sing these with a MIDI supplied melody. [6]

- Q3. (a) What are *critical bands* in relation to the human ear's perception of sound? [2]  
 (b) How does MPEG audio compression achieve critical band approximation? [3]  
 (c) List **three** coding methods in MPEG audio coding that exploit different perceptual characteristics of the human ear when hearing sound. Briefly explain how these arise in the human ear and how these methods are implemented in MPEG audio compression. [12]  
 (d) Given two stereo channels of audio:

Left Channel: 12 12 13 14 15 27 36 44  
 Right Channel: 12 14 16 4 44 20 2 3

- i. Apply Middle/Side (MS) stereo coding to the sequence. [6]  
 ii. How may this result be employed to achieve compression? Illustrate your answer with respect to the above data. [4]

- Q4. (a) What are the *target media* for JPEG compression? [2]  
 (b) What are the main *differences* between the target media for JPEG and GIF compression? [2]  
 (c) Compare the basic compression processes for JPEG and MPEG Intraframe coding. Your solution should outline the common basic processes for both, and particularly emphasise on the differences. Which steps in the process cause both JPEG and MPEG to be lossy? [13]  
 (d) Given the following portion from an 8x8 block from an image after the Discrete Cosine Transform has been applied:

128	64	46	128
128	32	64	160
32	16	12	32
4	31	40	32

- i. What is the result of the *quantisation step* of the MPEG compression method assuming that a constant quantisation value of 32 is used? [3]  
 ii. What is the result of the following *zig-zag step* being applied to the quantised block? [3]  
 iii. What is the result of the following *run length encoding (RLE)* step being applied to the zig-zagstep's output? [4]