

## **CITY UNIVERSITY OF HONG KONG**

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Course code & title : EE4115 Audio-Visual Engineering

Session : Semester B 2002/03

Time allowed : Two hours

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This paper has THREE pages (including this cover page).

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Instructions to candidates :

- (1) Answer any THREE questions.
  - (2) All questions carry equal marks.
  - (3) Answer EACH SECTION on a SEPARATE answer book
  - (4) Show clearly all essential steps and state any assumptions made.
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Materials, aids & instruments permitted to be used during examination:

City University Approved Electronic Calculator

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Special materials

Nil

**Answer any THREE questions**

**SECTION A**

**Question 1 (33 marks)**

- (a) Sketch and label the overall frequency spectrum of a *PAL* composite video and illustrate how the luminance and chrominance components are interleaved. (5 marks)
- (b) A black and white picture with a horizontal and vertical resolution of 1024 by 768 pixels is recorded as a composite video signal of the *PAL* standard. Assuming that the conversion is ideal, estimate the percentage of bandwidth that is lost as a result. (10 marks)
- (c) A sum and difference comb filter implemented with a delay line “*D*” and some simple supporting circuits can be employed to extract the *U* and *V* components of the *PAL* composite video signals. Due to the non-ideal characteristics of the comb filter each output will contain certain amount of luminance component. Determine the relative amount of the luminance signal (in *dB*) that is present at the output of the comb filter. (18 marks)

**Question 2 (33 marks)**

- (a) In the *JPEG* encoding standard, an image is first partitioned into non-overlapping sub-blocks of size  $N \times N$ , and each of them is transformed by *DCT*. Describe with the aid of diagram(s) how the *D.C.* coefficients are encoded with *DPCM* and the Huffman statistical model. (12 marks)
- (b) Does the encoding method describe in part (a) always results in reducing the data size needed to represent the *D.C.* coefficients? Explain your answer with a simple example. (8 marks)
- (c) A motion video with horizontal and vertical resolution of 1440 by 1152 pixels is encoded with the *MPEG II* standard. Describe with the aid of diagram(s) how the spatial scalability function should be designed so that the encoded video data can be played by three different decoders *A*, *B* and *C*. The resolution supported by each decoder is listed in Table Q2.

**Table Q2 – Resolution supported by each decoder**

|                       | Decoders |          |          |
|-----------------------|----------|----------|----------|
|                       | <i>A</i> | <i>B</i> | <i>C</i> |
| Horizontal Resolution | 1440     | 720      | 360      |
| Vertical Resolution   | 1152     | 576      | 576      |

(13marks)

## SECTION B

### Question 3 (33 marks)

- (a) The loudspeaker array of a PA system can produce a sound pressure level at  $L_p=110\text{dB}$ . The background noise level of the auditorium is measured to be  $45\text{dB}$  at  $1\text{KHz}$ . Estimate the acceptable distortion level allowed in this sound reproduction system? (9 marks)
- (b) Suggest two stereo microphone techniques for stereo recording. Comment on major differences between the recording methods you suggested. (8 marks)
- (c) What are the two major cues that determining the stereo perception. Briefly discuss the characteristic of these two cues and how they are used for stereo microphone recording techniques. (8 marks)
- (d) Explain how the human auditory system can be modeled. Also, explain how this model and its characteristics can be used in information coding used in data compression techniques such as ATRAC and MP3 compression techniques. (8 marks)

### Question 4 (33 marks)

- (a) With the aid of diagrams, explain the principle of operations of :  
(i) tracking, (ii) focusing and (iii) the data reading mechanisms used in mini or compact audio disc drives. (10 marks)
- (c) The EFM method is a modulation and encoding technique. How EFM can be used to reduce the system bandwidth requirement. (5 marks)
- (b) What are the advantages of using the ACIRC encoding technique over the CIRC? Draw a block diagram and explain the basic principle of operation of the CIRC used in a CD system. (8 marks)
- (d) In a magneto-optical recording/playback system, explain how data are recorded and read. How a MD system be used to read both the pre-mastered and the recordable discs. (10 marks)

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