



DUBLIN CITY UNIVERSITY

AUTUMN RESIT EXAMINATIONS 2011-2012

MODULE:
(Title & Code) EE554 Image and Video Compression

COURSE:
MEng in Electronic Systems (MEN)
MEng in Telecommunications Engineering (MTC)
Masters Engineering Qualifier Course (MEQ)
Grad Cert. in Electronic Systems (GCES)
Grad Cert. in Telecommunications Eng. (GCTC)
Graduate Diploma in Electronic Systems (GDE)
Grad Dip in Telecommunications Eng (GTC)

YEAR: 2011

EXAMINERS:
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TIME ALLOWED: 3 hours

INSTRUCTIONS: Answer any FOUR questions

Please do not turn over this page until instructed to do so

The use of programmable or text storing calculators is expressly forbidden.
Please note that where a candidate answers more than the required number of questions, the examiner will mark all questions attempted and then select the highest scoring ones

QUESTION 1

[TOTAL MARKS: 25]

1(a) [3 Marks]

Describe ONE example each of what is meant by SPATIAL, TEMPORAL and PERCEPTUAL redundancy in a video sequence.

1(b) [10 Marks]

1. Explain what is meant by the PREFIX CONDITION for variable length codewords. [2 marks]
2. Describe the practical difficulty encountered by a decoder for codewords which DO NOT obey the prefix condition. [5 marks]

HINT: use illustrative codewords and a sample message using these codewords to illustrate your answer.

3. Construct the LUT (look up table) required to decode the following codewords [3 marks]:

Symbol	Codeword
S_1	1
S_2	01
S_3	001
S_4	000

1(c) [8 Marks]

1. Briefly outline the TWO ways in which pixels are encoded in the Group 3 and Group 4 Fax coding standard. [5 marks]
2. Explain why EITHER approach to encoding is particularly suited to the kind of image data either standard could expect as typical input. [3 marks]

1(d) [4 Marks]

Explain HOW and WHY run length coding is used when source coding quantized DCT coefficients.

[End of Question 1]

QUESTION 2

[TOTAL MARKS: 25]

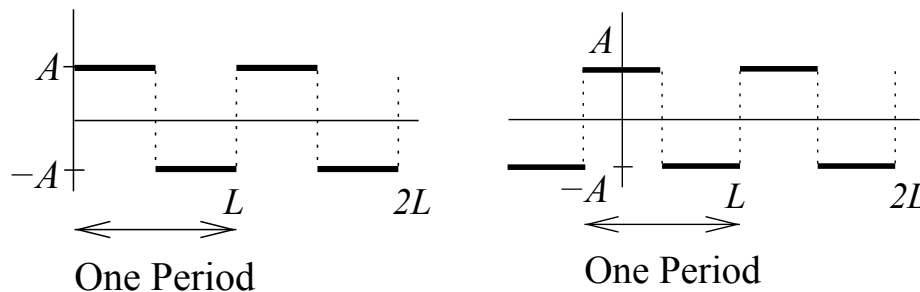
2(a) [2 Marks]

What is the meaning of the DC coefficient in a Fourier transform?

2(b) [4 Marks]

What is the difference between the a_n (cosine) and the b_n (sine) coefficients of a Fourier transform? What kind of property must the original function have in order to be approximated by only one of them? How does that relate to half-/quarter-wave symmetry?

2(c) [7 Marks]



The figure above shows two functions. Will there be a difference in their representation after Fourier transformation? Why? If there is a difference, what will it look like?

2(d) [12 Marks]

Suppose your task is to create a very simple image compression application that exploits an orthogonal transform (data acquisition and storage can be ignored — you can assume that the sampled data is already stored in computer memory). What kind of approach would you use to analyze this data? Describe the subsequent steps.

[End of Question 2]

QUESTION 3

[TOTAL MARKS: 25]

3(a)

[4 Marks]

1. What is the meaning of sequency? [2 marks]
2. Calculate sequencies for each row of the following matrix [2 marks]:

$$\mathbf{H}_8 = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 & 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 & 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 & 1 & -1 & -1 & 1 \\ 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 \\ 1 & -1 & 1 & -1 & -1 & 1 & -1 & 1 \\ 1 & 1 & -1 & -1 & -1 & -1 & 1 & 1 \\ 1 & -1 & -1 & 1 & -1 & 1 & 1 & -1 \end{bmatrix}$$

3(b)

[7 Marks]

Compare the following quantization tables. Consider the importance/priority of the particular DCT coeff. they give, the compression gain they could provide, and quality of the image compressed with their use.

8	16	19	22	26	27	29	34
16	16	22	24	27	29	34	37
19	22	26	27	29	34	34	38
22	22	26	27	29	34	37	40
22	26	27	29	32	35	40	48
26	27	29	32	35	40	48	58
26	27	29	34	38	46	56	69
27	29	35	38	46	56	69	83

1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1

3(c) [7 Marks]

Describe the JPEG coding procedure for DC coefficients emphasizing where compression occurs in the overall process.

3(d) [7 Marks]

Describe the JPEG coding procedure for AC coefficients, emphasizing where compression occurs in the overall process.

[End of Question 3]

QUESTION 4

[TOTAL MARKS: 25]

4(a)

[12 Marks]

1. Sketch the high level structure of a H.261 VIDEO ENCODER and briefly describe its operation. [5 marks]
2. In your diagram, indicate the DECODING components that are implicit components of the encoder. [3 marks]
3. List TWO coding events that undergo HUFFMAN CODING in H.261 encoding. [4 marks]

HINT: The term coding event refers to a specific piece of information that must be transmitted to the decoder within the H.261 syntax.

4(b)

[8 Marks]

Sketch the BITSTREAM DIAGRAM for the MACROBLOCK layer as specified for a H.261 video codec. Explain what each bitstream component/acronym refers to and specify whether it is encoded as a fixed length code or a variable length code.

NOTE: You DO NOT need to specify how many bits are used for each bitstream component.

4(c)

[5 Marks]

List the main differences between the H.261 and H.263 video compression standards in terms of the coding modes supported.

NOTE: you DO NOT have to explain the various H.263 coding processes alluded to, simply state the differences with respect to the corresponding processes in H.261.

[End of Question 4]

QUESTION 5

[TOTAL MARKS: 25]

5(a)

[9 Marks]

Consider the following statement:

“In order to facilitate scalability, a layered coding approach is adopted in the encoder.”

1. Explain what is meant by this statement. [3 marks]
2. What is meant by TEMPORAL SCALABILITY in the context of an MPEG-4 video encoding process? Explain the relationship between the different kinds of VOPS present in the different coding layers. Provide a diagram to illustrate your answer. [6 marks]

5(b)

[8 Marks]

Explain the method of binary SHAPE CODING employed in the MPEG-4 video compression standard as it applies to a given Binary Alpha Block (BAB). Use appropriate diagrams in order to illustrate your explanation.

5(c)

[5 Marks]

Explain what is meant by a NORMATIVE aspect of a video compression standard. Give ONE example of a normative aspect of the H.261 standard and ONE example of a normative aspect of the MPEG-4 standard.

5(d)

[3 Marks]

Consider the following statement:

“Although it leverages compression standards, MPEG-7 is itself not a compression standard, but rather a response to the growing availability of digital audiovisual content.”

Is this statement TRUE or FALSE? Provide a brief justification for your answer.

[End of Question 5]

[END OF EXAM]