SOLUTIONS

Module:	Interactive media design and production		
Module Code	EBU5305	Paper	A
Time allowed	2hrs	Filename	Solutions_1516_EBU5305_A
Rubric	ANSWER ALL QUESTIONS		
Examiners	Dr. Marie-Luce Bourguet	Dr. Ling Ma	

Question 1

a) Digitisation.

[5 marks]

i) Let n be the number of bits used to quantise a digital sample. What is the maximum number of values that can be represented?

(1 mark)

Solution: 2^n

ii) Let f be the frequency of a sine wave. What is the minimum sampling rate that can be used in the digitisation process so that the resulting digitised wave is not aliased?

(1 mark)

Solution: 2f

iii) Calculate the size in bytes of a video file, which has the following characteristics: frame size is 300 pixels x 200 pixels, true colour encoding, frame rate is 25 frames/s, no audio track, duration is 1 minute.

(3 marks)

Solution: number of pixels per frame: 300 x 200 = 60 000; true colour is 24 bits per pixel; total number of frames: 25 x 60 = 1500. Size in bytes: 60 000 x 24 x 1500 / 8 = 270 Mbytes.

b) Colour.

[5 marks]

i) Describe the properties of a fully saturated colour.

(1 mark)

Solution: a fully saturated colour contains no white.

ii) In the RGB colour model, how is the grayscale represented?

(1 mark)

Solution: by one number only, as R = G = B

iii) What (R, G, B) values would you use to encode an unsaturated bright green colour?

(1 mark)

Solution: (50, 255, 50) (the R and B values must be the same, but any value between 5 and 250 is okay)

iv) What (H, S, V) values would you use to encode a fully saturated dark red colour?

(1 mark)

Solution: (0, 100, 20) (V can be any value between 5 and 45)

v) Magenta ink is spread onto a white sheet of paper. What colour will you see if the paper is illuminated with a green light?

(1 mark)

Solution: black

c) Image compression.

[5 marks]

i) What image property is used in Run Length Encoding (RLE) to achieve compression?

(1 mark)

Solution: spatial redundancy, i.e. the fact that large areas of the image are made of one colour.

ii) How would you encode the following sequence of bytes using RLE, and how much compression do you achieve?

Sequence of bytes: ABCCCAAAABBBBCCCCCDD

(3 marks)

Solution: ABCCC!4A!4B!5CDD which is 16 bytes instead of 20 bytes achieving compression of 20/16 = 1.25. **Remark: we studied a different RLE encoding scheme this year**

iii) What is the most efficient image compression technique for a vector-based image?

(1 mark)

Solution: a vector based image does not need to be compressed.

d) Consider the 4x4 matrix of DCT coefficients shown in Table 1 below.

[5 marks]

1000	**35**	**100**	**40**
100	**100**	**25**	**20**
75	**80**	**40**	**20**
20	**10**	**5**	**2**

Table 1

i) Apply quantisation to the DCT coefficients of Table 1, using the quantisation matrix shown in Table 2, and calculate a new matrix of rounded quantised values.

(2 marks)

10	**20**	**50**	**99**
20	**50**	**99**	**99**
50	**80**	**99**	**99**
99	**99**	**99**	**99**

Table 2

Solution:

100	2	2	0
5	2	0	0
1	1	0	0
0	0	0	0

ii) How many values have been rounded to zero? Where are they located in the new matrix and why?

(2 marks)

Solution: 9 values, all located in the lower right area of the matrix, this is because the quantisation table contains big values in the same area in order to eliminate the coefficients that correspond to high frequencies.

iii) To obtain a better quality image after decompression, what would you change to the quantisation matrix of Table 2?

(1 mark)

Solution: use smaller values in order to obtain less zeros during quantisation

e) MPEG.

[5 marks]

i) What type of MPEG frame is not temporally compressed?

(1 mark)

Solution: I-frames

ii) What is encoded after motion estimation has been successfully performed on a macro block?

(2 marks)

Solution: the error terms and the motion vector.

iii) Why are B-frames typically more compressed than P-frames?

(2 marks)

Solution: because they can make better predictions thanks to using two reference frames rather than one.