

UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2000/2001

September/October 2000

CSC543 – Digital Image Processing

Duration : [3 hours]

INSTRUCTION TO CANDIDATE:

- Please ensure that this examination paper contains **SIX** questions in **THREE** printed pages before you start the examination.
 - Answer **ALL** questions.
 - You can choose to answer either in Bahasa Malaysia or English.
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1. (a) Discuss briefly the elements of a typical Digital Image Processing System.
(8 marks)
- (b) Explain 'sampling' and 'quantization' with respect to Image Processing.
(4 marks)
- (c) State the Convolution Theorem and explain its use in Image Processing.
(4 marks)
2. (a) Derive the transformation matrix for rotation of a point about the y axis by an angle p . Assume homogenous coordinates are used.
(6 marks)
- (b) The transformation of a cube located away from the origin is done by scaling transformation with respect to the coordinate origin. The scaling parameter was set to 2 uniformly in all the three principal directions. What is the effect of this transformation with respect to the location and size of the cube? Justify your answer by sketching the cube before and after transformation.
(10 marks)
3. (a) Describe briefly the two approaches, namely spatial domain methods and frequency domain methods, used for Image Enhancement.
(6 marks)
- (b) Explain, step-by-step, the procedure for enhancing an image by processing it so that its histogram has a specified shape. Illustrate your steps by suitable sketches.
(10 marks)
4. (a) Explain, with suitable sketches, the ideal high-pass and low-pass filter transfer functions, in the frequency domain.
(8 marks)
- (b) Under what condition does the Butterworth low-pass filter become an ideal low-pass filter?
(2 marks)

- (c) A given image was processed by a high pass filter and the image obtained was not what was required. How can you obtain, now, a low-pass filtered image without using a low-pass filter?
(2 marks)
- (d) What is image subtraction? Discuss typical usage of this processing technique.
(4 marks)
5. (a) Briefly describe the RGB and HSI color models.
(6 marks)
- (b) An image f undergoes geometric distortion to produce an image g . Explain the principle behind the use of tie points to recover the image f from the image g . Describe the procedure for the recovery.
(10 marks)
6. (a) Given 640-by-480-by-8 bit digitized television frames, each with a 1,024-byte label, and a lossless compression algorithm having a compression ratio of 4.25, how many seconds of (30 frame-per-second) video can you store on a disk drive with 220 megabytes of available space with and without compression?
(4 marks)
- (b) Explain the concept of progressive image transmission.
(4 marks)
- (c) Explain Huffman coding and Huffman's procedure to perform error-free image compression. Illustrate with the help of the 8 symbols whose probabilities are shown below:
(12 marks)
- | | | | |
|-------------|------------|------------|-------------|
| a - 0.25; | b - 0.25; | c - 0.125; | d - 0.125; |
| e - 0.0625; | f - 0.0625 | g - 0.0625 | h - 0.0625; |