On admission to the examination room, you should acquaint yourself with the instructions below. You must listen carefully to all instructions given by the invigilators. You may read the question paper, but must not write anything until the invigilator informs you that you may start the examination.

You will be given five minutes at the end of the examination to complete the front of any answer books used.

May/June 2015 **SE3IA11 2014/5 A 001**

2 Answer Books
Only CASIO fx-83ES or -83MS calculators permitted

UNIVERSITY OF READING

IMAGE ANALYSIS (SE3IA11)

Two Hours

Answer any **THREE** out of FOUR Questions.

Answer Question(s) from Section A and
Section B in separate Answer Books.

EACH Question is 20 marks.

Section A

1. (a) An edgel (or edge element) is an important symbolic image feature. Define the term 'edgel' and state TWO image analysis methods which use edgels.

(4 marks)

(b) Explain why 'Gaussian blur' and 'non-maximal suppression' are important in relation to feature extraction . State ONE method used in image analysis which utilises these processing steps.

(5 marks)

(c) A local borough council requires the detection and classification of different vehicle types in order to enforce valid use of bus lanes. This involves differentiating between valid vehicles (including buses, taxis and cycles) and all other vehicles.

Explain, with an appropriate set of at least THREE methods from image analysis, how you might detect and classify between different vehicle instances. State any assumptions that you make.

(11 marks)

2. (a) Define the term "image enhancement". Describe the main categories of enhancement used in image analysis and state an example of a method from each category.

(3 marks)

(b) Explain how psychovisual redundancy is achieved in the JPEG compression scheme . Is such compression lossless or lossy?

(5 marks)

(c) Compare and contrast the requirements for the effective compression of images acquired of:

(i) an indoor space surveyed by a fixed CCTV video camera;

(ii) the comet 67P/Churyumov-Gerasimenko captured by the European Space Agency's Philae spacecraft;

(iii) a person's biometrics (face and fingerprints) to be stored on an electronic passport (e-passport).

State any assumptions that you make.

(12 marks)

Section B

3. (a) Image quality is affected by an optical imaging system. Give the definition of the Point Spread Function (PSF) in an imaging system, and briefly explain how to reduce the negative effect of PSF to an image by using digital image processing techniques.

(5 marks)

(b) The basic operations of Dilation and Erosion in morphologic image processing can be extended to grey-scale images.

(i) Give the definition of Dilation and Erosion for grey-scale images in a mathematical form;

(ii) State under what circumstances the two operations should be applied to a grey-scale image.

(5 marks)

(c) Figure Q3 shows an image of stem-cells which contains noise. You are required to develop an algorithm which can automatically count the number of cells (blue kernels surrounded by red wrap) in the image.

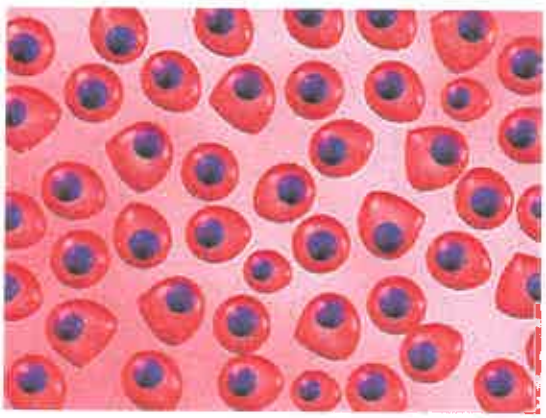

Figure Q3. Cell image.

Devise your algorithms step by step, and state any assumptions you make in your answer.

(10 marks)

4. In a CCTV video clip, a car is moving along a street where there are greenish trees. You are required to develop an algorithm to segment the moving car and stationary trees.

(a) Is it suitable to use a global thresholding process for segmenting the moving car? Briefly justify your answers. (5 marks)

(b) Design an algorithm which can identify the greenish trees from the scene. State possible flaws and assumptions in your design. (5 marks)

(c) Both the basic approach for detecting changes between two image frames and a Gaussian model can be used for motion segmentation. Compare and contrast the TWO methods in moving car segmentation. (10 marks)

(End of Question Paper)