PRIFYSGOL ABERYSTWYTH UNIVERSITY

SEMESTER TWO 2025–2026

COMPUTER SCIENCE

CS24320 : APPLIED GRAPHICS

Time allowed: **2 HOURS**

Answer all **FOUR** questions

All questions carry equal marks.

YOU MAY BRING THE FOLLOWING INTO THE EXAMINATION:
UP TO 3 SHEETS OF NOTES ON A4 PAPER (WHICH MAY BE DOUBLE-SIDED). THERE ARE NO ADDITIONAL RESTRICTIONS ON CONTENT OR FORMATTING OF THESE NOTES.
NO ELECTRONIC DEVICES.

CALCULATORS ARE PERMITTED (CASIO FX991, FX83 OR FX85 MODELS ONLY)

STUDENTS MAY SUBMIT ANSWERS TO THIS PAPER IN EITHER WELSH OR ENGLISH

Once seated, students may complete the front cover of the answer book(s) and the attendance slip ONLY.

DO NOT TURN THE EXAMINATION QUESTION PAPER OVER UNTIL INSTRUCTED TO DO SO.

1. **2D image processing**

a) **Image capture and colour**

(i) Explain the terms *sampling* and *quantisation* and how they relate to image *digitisation*. [4 marks]

(ii) Colour images are often captured with an image sensor (e.g. a Bayer sensor) that has as many green sensors as there are red and blue sensors combined. Referring to what you know about colour perception, explain why this pattern is used. [5 marks]

(iii) Consider the following sequence of operations in GIMP:

- From the *Colours/Components* menu, *Decompose...* is selected and *HSV* is chosen from the resulting dialog.
- The *saturation* layer is selected from the decomposed image's layers.
- Using the *Colours/Levels* tool, the output level range is set from 0 to 0.
- On the *Colours/Components* menu, *Recompose...* is selected.

Describe the appearance of the final image (given that the input is a normal RGB colour image) and explain your reasoning. [6 marks]

b) **Image filtering and blending**

(i) What is a *Layer Mask* and how are they used in GIMP? [4 marks]

(ii) What is *morphological* filtering and how could it be applied to fill small holes in a Layer Mask? [6 marks]

2. **3d**

a) **Modelling**

(i) List the three core elements which make up a *polygon mesh*, and explain briefly how each contributes to the form and appearance of the mesh. [6 marks]

(ii) What is a *normal vector*? Provide an example of how you can use them for increased efficiency. [4 marks]

(iii) How is *Constructive Solid Geometry* (CSG) different to modelling meshes using classic topological editing? [3 marks]

b) **Lighting, Materials, and Textures**

(i) What is *Lambertian Shading*? [2 marks]

(ii) What is the difference between *glossy* and *specular* in material and light interaction? [4 marks]

(iii) Explain how *materials*, *textures*, and *lighting* each contribute to the visual appearance of an object being rendered. [6 marks]

3. **3d**

a) **Animation**

(i) Explain the difference between *Forward Kinematics* and *Inverse Kinematics*. [6 marks]

(ii) The list below contains a selection from the 12 *Principles of Animation*. Choose any three from this list, explain their purpose and how they can be used:

- Squash and Stretch
- Anticipation
- Arc
- Secondary Action
- Exaggeration
- Appeal

[6 marks]

(iii) In *physics-based animation* we can use rigid bodies and soft bodies, explain what each is and note some of the things we should consider when choosing between which to use. [6 marks]

(iv) What is a *bounding volume*, and how can one be used in collision detection? [3 marks]

(v) What are some of the potential issues with collision detection? [4 marks]

4. **Video editing and compression**

a) **Video editing**

(i) Explain what *Split* and *Hold Split* do in the Blender Video Editor, and the difference between them. [3 marks]

(ii) Explain the terms *Chroma-keying*, *Despill* and *Clip white* in relation to the Blender Compositor *Keying* node. [7 marks]

b) **Video compression**

(i) Explain the terms *lossless* and *lossy* in the context of image compression. [3 marks]

(ii) What are I, P and B frames used in MPEG compression and how do they improve the compression? [6 marks]

(iii) Outline how *MPEG encoding* uses local and global *motion compensation* to improve the compression. [6 marks]

END OF PAPER