

1. (a) Explain how the human visual system's capabilities are exploited by computer graphics. [4]
- (b) What are the standard components of a graphics system? Illustrate with a diagram the main stages of a 3D viewing pipeline. [7]
- (c) In OpenGL, what are matrix stacks? What do the following statements each do and which matrix stack would you normally use them on?
  - i. `gluOrtho2D(0, 1000, 0, 1000);`
  - ii. `glTranslatei(500, 500, 0);`  
`glScalef(2.0f, 2.0f, 1.0f);`[7]
- (d) Show how a rotation of  $\theta$  about an arbitrary axis,  $(a, b, c)^T$ , through the origin, can be achieved by suitable rotations about the principal axes of  $\theta_x$  and  $\theta_y$  and  $\theta_z$  respectively. Calculate coefficients of rotation matrices  $R_x(\theta_x)$  and  $R_y(\theta_y)$  and give a set of OpenGL statements which will perform  $R(\theta)$ , if the angles are given in degrees. [7]