UNIVERSITY OF VICTORIA
FINAL EXAMINATIONS APRIL 2013
CSC 305: INTRODUCTION TO COMPUTER GRAPHICS

Instructor: B WYVILL   Duration: 120 minutes

TO BE ANSWERED IN EXAM BOOKLETS

STUDENTS MUST COUNT THE NUMBER OF PAGES IN THIS EXAMINATION PAPER BEFORE BEGINNING TO WRITE, AND REPORT ANY DISCREPANCY IMMEDIATELY TO THE INVIGILATOR.

THIS QUESTION PAPER HAS 2 PAGES INCLUDING THIS PAGE.

Instructions

- Please fill in your **name** and **ID number** on the exam booklet.

- All answers are to be provided in the exam booklet.

- Full marks may be obtained for correct answers to four questions.

- **Show all your work, for every question.**

- This is a closed-book exam but a single sided sheet of notes is permitted.

- Calculators are permitted.

- State any assumptions you make.

- Ensure all cell phones are turned off.

- You are required to remain for the first 30 minutes.

Question 1 .... *(4 points)*
   Shading

   (a) Given a viewer positioned at $V = (-7, 9, -5)$, a light at $L = (203, 104, 205)$ and $\boxed{4}$
       a surface given by the 3 points $P_0 = (3, 4, 5)$, $P_1 = (3, 4, 6)$ and $P_2 = (4, 4, 5)$.
       Calculate the surface colour at P_0 using the Phong illumination model, as-
       suming that the light's colour is $C = (1, 1, 1)$ and the ambient and diffuse
       colour of the surface is $I_a = I_d = (0.8, 0.2, 0.3)$. The ambient coefficient is
       $K_a = 0.2$, the diffuse coefficient $K_d = 0.6$ and the specular coefficient is
       $K_s = 0.2$, with specular power being $n = 20$. Use white as the specular colour
       I_s. Describe which version of the Phong illumination model you use.

Question 2 .... *(4 points)*
   Ray-tracing

   (a) Given a sphere, centred at $C = (14, 6, 11)$ with radius 2 and a ray originating $\boxed{4}$
       at $O = (2, 0, 1)$ and direction $D = (2, 1, 2)$. Intersect the ray with the sphere
       and calculate the position and normal of the closest hit point.

Question 3 .... *(4 points)*
   Implicit modelling

   (a) Two skeletal point primitives are located at $P_0 = (-0.5, 0, -0.5)$ and $P_1 = \boxed{4}$
       $(0.5, 0, 0.5)$. These two primitives are combined using the standard summa-
       tion blend and the field values calculated from the function: $f(d) = 1$ for
       $d < 0$, $f(d) = (1 - d^2)$ for $d \in [0, 1]$ and $f(d) = 0$ for $d > 1$ where d is the
       distance of the point P from the skeleton point. Calculate the field-value at
       $P = (0, 0, 0)$ and determine if P is inside/outside or on the surface given the
       iso-value $c = 0.5$.

Question 4 .... *(4 points)*
   Splines

   (a) Given four points $P_0 = (0, 3, 4)$, $P_1 = (2, 5, 8)$, $P_2 = (3, 2, 6)$ and $P_3 = (0, 6, 5)$. $\boxed{4}$
       Calculate the coefficients to build a Catmul-Rom spline and evaluate the
       spline with tension $\tau = 0.5$ at $t = 0.5$ (hint: $P_i = P_2$).

Question 5 .... *(9 points)*
   Theory

   (a) Distinguish between parametric and modelling space for parametric curves. $\boxed{2}$

   (b) Why is the distance in skeletal implicit modelling modified by a field func- $\boxed{2}$
       tion?

   (c) Describe the Phong light model and the Phong shading model. A polygonal $\boxed{3}$
       mesh is used to approximate a smooth curved surface. If Goraud shading
       and the Phong light model is used, describe how it is possible that a specular
       reflection can be missed?

END