Department of Computer Science and Engineering
BRAC University

Set A

Examination: Semester Final | Semester: Summer 2025
Duration: 1 hour 50 minutes | Full Marks: 40

CSE 423: Computer Graphics

Name:	ID:	Section:

[Answer the following questions. Understanding the questions is part of the examination. So, do not ask for any clarification of the questions.]

Question 1 [CO1]

a. In the **HSV/HLS** model, complementary colors are **180°** apart on the **Hue circle**. **Explain why** complementary colors are defined this way in **HSV/HLS**. **Analyze** how changes in brightness influence the colors in the **HSV** model. **[2+2]**

b. A point **P** divides the line segment **AB** in the ratio 2: 3. The color of point **A** is **(0.04, 0.04, 0.14)** in the **CMY** color model, and **B** is **(0.60, 0.74, 0.87)** in the **RGB** color model. **Identify** the color of P in the **HSV** color model, using **Gouraud's shading**. **[2+4]**

Question 2 [CO2]

a. *"To make a shiny metal ball more mirror-like and focused, one should increase both the specular reflection coefficient and the specular exponent of the material."* **Do you agree or disagree** with the statement? **Justify** your reasoning by clarifying the difference between the roles of the specular reflection coefficient and the specular exponent in controlling shininess. **[1+3]**

b. A point **P** located on the **YZ plane** has the coordinates of **(5, 4)**. The scenario has a **constant ambient intensity vector** (i.e., all components are the same) of **5**, and there are **two light sources**, **A** and **B,** in the room, having an **influence diameter** of **12** and **25,** respectively. Light **A** has a **diffuse intensity vector** of **<2, 5, 4>** and a **constant specular intensity vector** of **4**. Similarly, light **B** has a **diffuse intensity vector** of **<3, 7, 10>** and **a specular intensity vector** of **<10, 10, 9>**. The **ambient coefficient vector** is **<0.3, 0.2, 0.7>**, the **diffuse coefficient vector** is **<0.4, 0.1, 0.3>,** and the **specular coefficient** is **0.5**. The **specular exponent** of the point is **64**. The Light source **A** is located on **(9, 3, -2),** and Light source **B** is located on **(7, 4, 8)**. The **viewpoint** is located on **(-2, 7, -1)**.

Given all the above information, **determine** the **total reflected light intensity** on the incident point using **Blinn and Torrence Variation** of **Phong's illumination model**. **[6]**

N.B. Here, the vector values represent RGB values, respectively.
(Hint: Calculate the attenuation factor of the light sources first)

Question 3 [CO3]

a. An object is projected onto the $y = -423$ plane with parallel projectors that are not perpendicular to the plane. **Identify** the projection type and **derive** the corresponding **4×4** projection matrix. **[1+3]**

b. A point **P(15, 25, 400)** is projected onto the **Projection Plane**. The **Center of Projection** (COP) is positioned at coordinates **(21, 10, 35)**, and the projection plane is placed **250 units** away from the COP. **Calculate** the projected point **P′** of point **P** onto the projection plane. If the projection plane is moved farther away from the COP, **how** does the projected point, **P′**, change in appearance? **[5+1]**

Question 4 [CO2]

a. **Differentiate** between quadratic and cubic splines with respect to the tangents at their endpoints. **Derive** the tangent expressions for both spline types, and **justify why** cubic splines are generally preferred. **[4]**

b. A piecewise spline, $f(t)$, is defined as:

$f(t) = (1.5t^2 - 0.5,\ 4t^{-3})$, when $t \leq 1.0$

$f(t) = (t^3,\ 1 + 3t^{-4})$, when $t > 1.0$

Find the maximum value of n for $G(n)$ and $C(n)$ continuity separately at $t = 1.0$. **Analyze** whether the splines join smoothly by examining their continuity conditions. **[4+2]**

********** **The End** **********