BRAC University (Department of Computer Science and Engineering)

CSE 423 (Computer Graphics) for Summer 2022 Semester

Quiz 4

Full Marks: 10
Duration: 30 minutes

Student ID:
Name:

[No extra sheet will be provided. Write your answer to the questions in this answer script.]
[Marks allocated to each question is given in the statement of corresponding question.]

1. **A light source with intensity 5 and radius of influence 50 is located at point (2,3,4) from which you are called to calculate the illumination of a point on the xy plane. The camera is set at a point (5,6,3) and the light is reflected back from point (4,4) of the plane. The ambient, diffuse and specular coefficient is given at 0.2, 0.5, 0.4.**
   a. **For the above phenomenon, represent the reflected ray R in the unit vector.** 3
   b. **Calculate the specular reflection intensity for a shininess factor of 10.** 2
   c. **Calculate the attenuation factor for the given point in the above scenario.** 2
   d. **If the ambient light intensity is at 2, calculate the total reflected light intensity at the given point according to phong's model with the attenuation factor.** 3

(a) Here, $\hat{n} = \hat{k}$

$L = (2,3,4) - (4,4,0)$
$= (-2,-1,4)$

$\therefore \hat{L} = \dfrac{(-2i - j + 4k)}{\sqrt{21}}$

$\therefore \hat{L}.\hat{n} = \frac{1}{\sqrt{21}}(-2i - j + 4k).\hat{k}$

$= \frac{4}{\sqrt{21}}$

$\therefore 2(\hat{L}.\hat{n})\hat{n} = \frac{8}{\sqrt{21}}\hat{k}$

$\therefore \bar{R} = 2(\hat{L}.\hat{n})\hat{n} - \hat{L} = \frac{8}{\sqrt{21}}\hat{k} - \frac{(-2i - j + 4k)}{\sqrt{21}}$

$= \underline{\frac{1}{\sqrt{21}}(2i + j + 4\hat{k})}$

(b) $\bar{V} = (5,6,3) - (4,4,0)$
$= (1,2,3)$

$\hat{V} = \frac{1}{\sqrt{14}}(\hat{i} + 2\hat{j} + 3\hat{k})$

$$\therefore \hat{R}\cdot\hat{V} = \frac{1}{\sqrt{21}}(2\hat{i}+\hat{j}+4\hat{k})\cdot\frac{1}{\sqrt{14}}(\hat{i}+2\hat{j}+3\hat{k})$$

$$= \frac{1}{\sqrt{294}}(2+2+12)$$

$$= \frac{16}{\sqrt{294}}$$

$$\therefore I = I_p k_s \left(\frac{16}{\sqrt{294}}\right)^n$$

$$= 5 \times 0.4 \times \left(\frac{16}{\sqrt{294}}\right)^{10}$$

(c) $$f_{att} = \max\left(1-\left(\frac{d}{r}\right)^2, 0\right)$$

$$= \max\left(1-\left(\frac{d}{50}\right)^2, 0\right)$$

now, $$d = \sqrt{(2-4)^2+(3-4)^2+(4-0)^2}$$

$$= \sqrt{4+1+16}$$

$$= \sqrt{21}$$

$$\therefore f_{att} = \max\left(1-\frac{21}{50^2}, 0\right)$$

$$= 0.9916$$

(d) $$I = I_a k_a + I_p f_{att}\left(k_d \max(\bar{L}\cdot\bar{n}, 0) + k_s(\max(\bar{v}\cdot\bar{r}, 0))^n\right)$$

$$= 2\times 0.2 + 5\times 0.9916\left(0.5\times\frac{4}{\sqrt{21}} + 0.4\times\left(\frac{16}{\sqrt{294}}\right)^{10}\right)$$

(Ans.)