CSE-423 Assignment

Question-1:

1.Given a point P(x,y,z). Find out the output point if we rotate the point P at an angle θ counterclockwise when the center of rotation is (a,b,c).

2.Given a point A(12,10,5). P is rotated 30 degree clockwise across the z axis, then 45 degree counterclockwise across y axis and then rotated 60 degree clockwise across x axis with respect to point (2,4,6). Find out the output point after applying these operations.

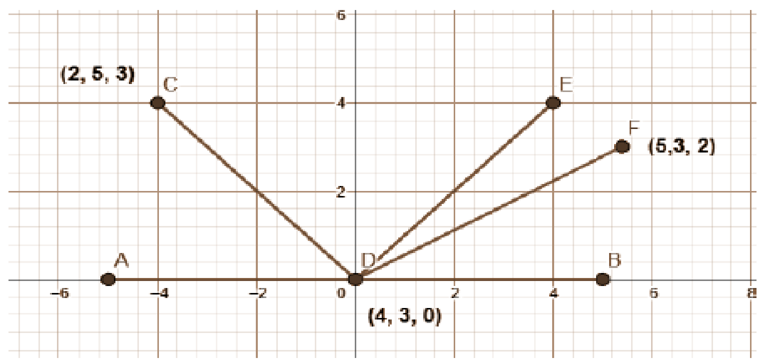
3.Calculate the projected point coordinates for a point (30,50,-250) where COP is at (100,90,0) and the projection plane is at distance of 200 from COP.

4.The coordinate of the light source (-56,700,1000) and the Intensity is 0.95 , point (-25,50,50). Light diffuse absorption coefficient 0.95 , center is at origin. What is the intensity of the reflected light?

5.Calculate the intensity of reflected light at a point (20,15,100) on a sphere where Ia = 0.2 , Ka=0.5 , Is=0.5 , Kd=0.6 and the light source is at (50,30,500)

See next page

Hard Question :

2		A light source with intensity 5 and radius of the sphere of influence 21 is located at a point **C**(2, 5, 3) from which you are supposed to calculate the illumination of a point on the xy plane. The camera is set at a point **F**(5, 3, 2) and the light is reflected back from the point **D**(4, 3) of the plane. The ambient, diffuse and specular coefficient is given as 0.3, 0.1, 0.5. 	

	CO1	a.	Theoretically Phong's model should follow the inverse square law ($f_{att}= 1/d^2$) for calculating attenuation but it does not follow the same formula in practical terms. State the formula that Phong's model uses to calculate attenuation and point out the reasons why it is changed.	**2**
	CO1	b.	For the above phenomenon, show the reflected ray **E** in the unit vector format.	**3**
	CO1	c.	State the equation to calculate total reflected light intensity for ambient, diffuse and specular reflection using Phong's model.	**1**
	CO2	d.	Measure the total reflected light intensity at the given point according to Phong's model (with attenuation factor) where shininess factor is 6 and ambient light intensity is 2. *Note: Consider attenuation only from light source to surface.*	**4**

To solve this question you can take help from this solution →

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, $\hat{n} = \hat{k}$ $\quad L = (2,3,4) - (4,4,0)$

$$= (-2, -1, 4)$$

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

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

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

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

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

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

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

$$= (1,2,3)$$

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

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

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

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

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

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

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

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

$= \sqrt{21}$

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

$= \underline{\underline{0.9916}}$

(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.)