

**BRAC UNIVERSITY**  
**Department of Computer Science and Engineering**

Examination: Final Exam  
Duration: 1 hour and 30 minutes

Semester :Spring 2022  
Full Marks: 30

**CSE 423: Computer Graphics**

Name:	ID:	Section:
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**Instructions:**

1. Answer all of the following questions.
2. Figures in the right margin indicate marks.
3. Non programmable calculators are allowed.

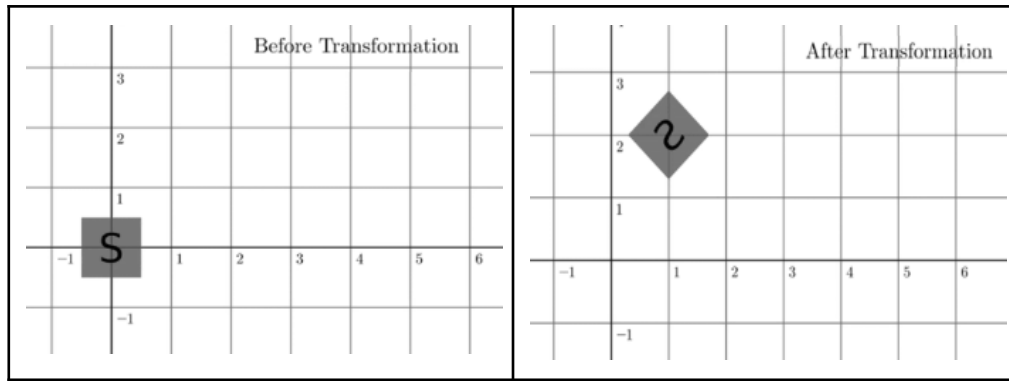
**Questions:**

1. a. Explain in short - in what perspective solid modeling is better than shell modeling? **01**  
b. Name the most common polygon used for model representation and mention why it is used so frequently? **02**  
c. What are the condition(s) that a transformation ( $T : U \rightarrow X$ ) needs to satisfy to be considered as a Linear Transformation? **02**  
d. Find the matrix that represents rotation of an object by  $30^\circ$  (counter-clockwise) about the origin. **02**  
e. What are the new coordinates of the point P (3, -7) if the above rotation is applied? **01**  
f. Find the new coordinate of the point P (-5, 7) after a simultaneous shear where shear factor is 2 in X-axis direction and shear factor is 5 in Y-axis direction. **02**
2. Consider the following list of transformations.
  1. A reflection across the Y-axis.
  2. A counterclockwise rotation by 45 degrees.
  3. A translation of 1 unit to the right followed by a translation of 2 units upwards.
  4. A reflection across the line  $y=x$ .

Now answer the following questions.

- a. Write down the transformation matrices corresponding to transformations (1), (2) and (3). Use homogeneous coordinates. **03**
- b. In what order should you apply transformations (1), (2) and (3) to achieve the overall transformation indicated by the figure below? **02**

*[image on next page]*



- c. Your friend wants to find the transformation matrix corresponding to the transformation (4). However, she only knows how to reflect something across the Y-axis. You tell her that in order to reflect something along the  $y=x$  line, she can - **05**

- First, apply a rotation transformation such that the line  $y=x$  becomes the Y-axis.
- Then perform a reflection across the Y-axis.
- And finally apply the inverse of the transformation in (i).

Now, write the matrices for (i), (ii), (iii) and the final transformation matrix which combines all three.

3. To answer some of the following questions, you will need four variables **A**, **B**, **C** and **D** which are sequentially the first, second, third and fourth pair of digits from the left in your student ID.

For example, if your ID is 15101208, then  $A=15$ ,  $B=10$ ,  $C=12$  and  $D=8$ .

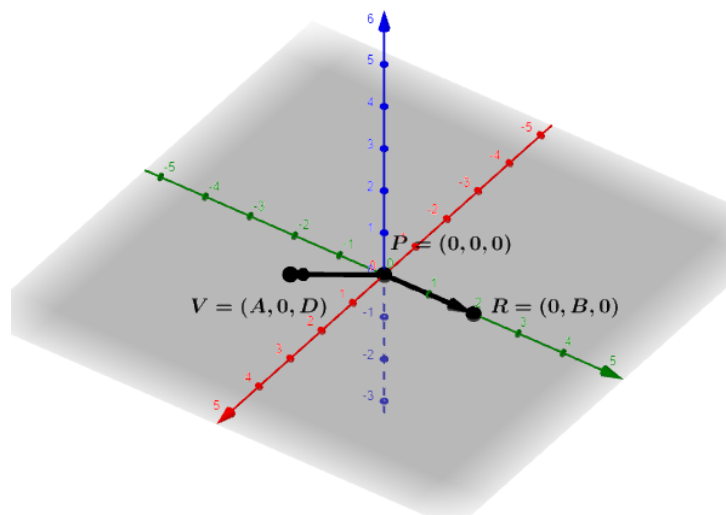
- a. Given below is the equation for Phong's Illumination model. Mention what each of the variables represent. **04**

For example,  $I_a$  represents intensity of ambient light.

$$I = I_a * K_a + I_p * f_{att} ( K_d * \max (L.n, 0) + K_s * \max (V.R, 0)^n )$$

- b. Imagine you want to find the specular reflection at the origin  $P=(0,0,0)$ , where light is being reflected along the vector  $R = (0, B, 0)$ , and the viewer is at the point  $V = (A, 0, D)$ . **02**

What will be the specular reflection at the origin? given that, shininess constant,  $n = 3$ ; intensity of light,  $I_p = 0.5$ ; and specular coefficient,  $K_s = 0.5$



- c. Continuing from 3(b), If the viewer changes location to  $(A, -2, D)$ , what should be the new specular reflection that the viewer sees? **02**
- d. Imagine that there is a light source at  $(D, D, D)$ , and we want to find the diffuse reflection from the origin  $(0, 0, 0)$ , which is a point on a flat object. The flat object is kept aligned to the x-y plane. **02**

Given that, intensity of light,  $I_p = 9$  and diffuse coefficient,  $K_d = 0.5$ , what will be the amount of diffuse reflection?