**BRAC UNIVERSITY**

**Department of Computer Science and Engineering**

| Examination: Final Exam  Duration: 1 hour and 30 minutes | Semester :Spring 2022  Full Marks: 30 |
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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 → X ) needs to satisfy to be considered as a Linear Transformation? | **02** |
|  | d. | Find the matrix that represents rotation of an object by 30⁰ (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?  *[image on next page]*   |  |  | | --- | --- | | **02** |
|  | 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 -  i. First, apply a rotation transformation such that the line y=x becomes the Y-axis.  ii. Then perform a reflection across the Y-axis.  iii. 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. | **05** |
|  |  |  |  |
| 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.  *For example,* ***Ia*** *represents intensity of ambient light.* | **04** |
|  | 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).  What will be the specular reflection at the origin? given that,  shininess constant, ***n* = 3**; intensity of light, **Ip = 0.5**; and specular coefficient, **Ks = 0.5** | **02** |
|  |  |  |  |
|  | 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.  Given that, intensity of light, **Ip = 9** and diffuse coefficient, **Kd = 0.5**, what will be the amount of diffuse reflection? | **02** |