(3 hours) **Total Marks: 80**

N.B. 1. Question **No. 1** is compulsory
2. Attempt any **three** questions from remaining five questions
3. Assume suitable data if **necessary** and justify the assumptions
4. Figures to the **right** indicate full marks

Q1 Answer any four questions.

A Define the terms Virtual Reality. Explain all the components of the definition in detail. **05**

B Explain six degrees of freedom. **05**

C What is a scene graph? Explain giving examples. **05**

D Explain the Software Engineering requirements that must be addressed when developing AR applications. Illustrate each requirement with an example. **05**

E Explain the applications of AR in education and medical fields. **05**

Q2 A Perform the following transformations on a triangle PQR whose coordinates are P(3,3), Q(6,6), R(8,4). Specify the matrices used. **10**

1. Rotate the triangle by 45^o.
2. Reflect the triangle about the Y axis.
3. Reflect the triangle about X=Y.
4. Apply the scaling parameter 3 along X axis and 5 along Y axis.
5. Apply the shear parameter of 2 along both the axes.

B Explain calibration, tracking and registration with respect to AR in detail. **10**

Q3 A What are the AR application requirements? Explain each one in detail giving examples. **10**

B What is camera calibration? Explain the different camera calibration techniques in brief. **10**

Q4 A Explain the yaw, pitch and roll in detail. **10**

B What are the common symptoms of VR sickness? Explain each one briefly. **10**

Q5 A Explain the architecture of the AR system. Explain each component in detail. **10**

B What is tracking in AR? How are the tracking techniques categorized? Explain markerless tracking techniques in detail. **10**

Q6 A Explain the following concepts with respect to auditory perception: **10**

1. Precedence effect
2. Localization

B What is sensor fusion? Explain competitive and cooperative sensor fusion. **10**

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