Indian Institute of Technology Jammu
Department of Computer Science & Engineering

Class Test 2, June 14, 2025

Course	: UG/ PG/PhD	Course Name	: Computer Vision
Course Code	:CSC003P5E	Time	:1 hour
Total Marks	: 10		

Instructions:
• Conditions of Examination: Closed book; No Mobile; No Laptop; Scientific calculator is allowed.
• This question paper contains a total of 3 Questions. Make an appropriate assumption wherever necessary.

1. [4 Point] A given camera is calibrated to produce the following intrinsic matrix.

$$\begin{bmatrix} 300 & 0 & 300 \\ 0 & 300 & 200 \\ 0 & 0 & 1 \end{bmatrix}$$

Consider a situation where the camera is oriented relative to the world coordinate system such that it has a pose described by the following rotation matrix and translation vector.

$$R = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}, t = \begin{bmatrix} 10 \\ 15 \\ 10 \end{bmatrix}$$

Compute the corresponding 3 x 4 camera matrix.
Using the resulting camera matrix compute the projection of the 3D world point P (Consider as a homogeneous point)

$$\begin{bmatrix} 20 \\ 20 \\ -10 \\ 1 \end{bmatrix}$$

2. **(a) [1.5 Point]** Given two ideal pinhole cameras where:

- the baseline of the two cameras is parallel to their scanlines,
- the optical axes of the two cameras intersect to form an angle of 90 degrees,
- the two centers of projection are at equal distances from the intersection of the optical axis, and
- the field of view of each camera is 90 degrees.

Draw the epipoles and a few epipolar lines.

(b) [1.5 Point] Draw illustration to show brightness constancy and smoothness constancy constraints in terms of (in terms of I, I_t, u, v, uu, vv) . Also write the supporting equations.

(c) [1 Point] Explain the use of first and second order derivatives in optical flow.

3. [2 Point] Given a 3D scene and *you have two images* taken of this scene from the *same camera* at different position and orientation.

(a) How can you estimate the Fundamental Matrix from this setup?
(b) How can you estimate the Essential Matrix?

Provide the steps in answer as short bullet points.