Birla Institute of Technology & Science, Pilani
First Semester 2022-2023
Comprehensive Examination

Course No.	: ME F342/ MF F342	**Name:**
Course Title	: COMPUTER AIDED DESIGN	**Id:**
Nature of Exam	: Open Book	
Weightage	: 35%	No. of Pages = 1
Duration	: 3 Hours	*No. of Questions = 5*
Date of Exam	: 22/12/2022	

Note: .
1. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
2. Assumptions made if any, should be stated clearly at the beginning of your answer.

Q.1. The corners of a wedge shaped block are **A**(0, 0, 2), **B** (0, 0, 3), **C** (0, 2, 3), **D**(0, 2, 2), **E** (-1, 2, 2) and **F**(-1, 2 ,3) and the reflection plane passes through the *y*-axis at 45^0 between negative *x* axis and positive *z* axis. Determine the reflection of the wedge.

[7]

Q.2. Show that the reflection of a 2D object about an arbitrary line $ax + by + c = 0$ is given by:

$$\frac{1}{a^2+b^2}\begin{bmatrix} b^2-a^2 & -2ab & -2ac \\ -2ab & a^2-b^2 & -2bc \\ 0 & 0 & a^2+b^2 \end{bmatrix}$$

[**6**]

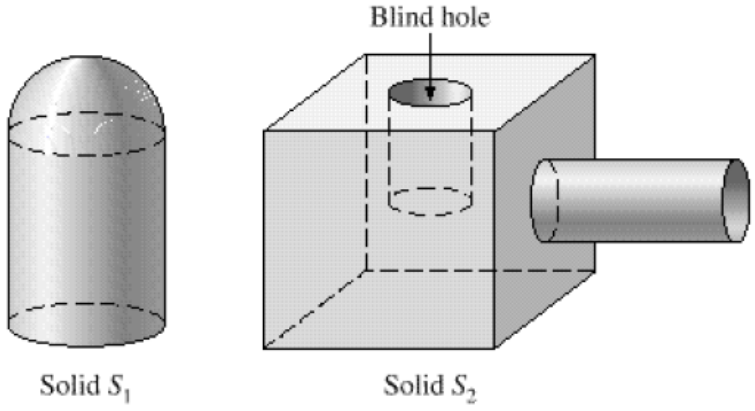
Q.3. (a) Find the equation of cubic spline segment with end position vectors $\mathbf{P}_0$ (0, 0), $\mathbf{P}_1$ (3, 4) and the tangent vectors $\mathbf{P}_0' = \begin{bmatrix} -1 & -1 \end{bmatrix}$ and $\mathbf{P}_1' = \begin{bmatrix} 1 & 1 \end{bmatrix}$ for the parameter t ($0 \le t \le 1$) using normalized approximation.

(b) The defining polygon points are given by $\boldsymbol{B_1}[0,0]$, $\boldsymbol{B_2}[1,3]$, $\boldsymbol{B_3}[2,1]$ and $\boldsymbol{B_4}[3,2]$. Find the starting and end points of fourth order periodic B-spline curve if double coincident vertices are used at both ends.

[4 + 4 = 8]

Q.4. Sweep the planar square defined by vertices $\mathbf{P_1}$[0 -1 0], $\mathbf{P_2}$ [0 -1 -1], $\mathbf{P_3}$ [0 1 -1], $\mathbf{P_4}$ [0 1 1] along the path $x = 10s$, $y = \cos(\pi s) - 1$ while maintaining the normal to the polygon in the instantaneous direction of the tangent to the path. **[7]**

Q.5. Verify the Euler equation for the two solids shown below:



[7]

****