

Birla Institute of Technology & Science, Pilani
Second Semester 2022-2023

Mid-Semester Examination

Course : ME F318 Computer-aided design
Nature of Exam : Closed Book
Weightage : 25% (As per Course Handout) – 50 marks
Duration : 1.30 Hours
Date of Exam : 14/03/2022 09:00 AM to 10:30 AM

No. of Pages	= 1
No. of Questions	= 5

Note to Students:

1. All parts of a question should be answered consecutively.
2. Each answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.
4. Do NOT write in your answer sheet after the exam duration.

- Q.1. An engineer traces a point on the rim of a bicycle wheel as it rolls over a flat surface without slipping. Derive parametric equation of the curve traced by the engineer using the concept of recursive relation. Assume the origin to be located at a point where all the spokes intersect. **[15 marks]**
- Q.2. The rim of the bicycle wheel is represented by a circle (of center P_c) that passes through three points, $P_0 [2,2]$, $P_1 [3,4]$ and $P_2 [4,3]$. Write the parametric equation of line joining P_0 and P_c . **[5 marks]**
- Q.3. Three Hermite cubic spline curves are to be used to design the path of a roller coaster ride. Seg-1 with $P_0 [3,3]$ & $P_1 [5,4]$ | Seg-2 with $P_1 [5,4]$ & $P_2 [7,6]$ | Seg-3 with $P_2 [7,6]$ & $P_3 [9,7]$. Tangent vectors (TVs) at P_0 and P_3 are $[3,0]$ and $[3,0]$, respectively. Evaluate intermediate TVs in terms of data points and associated TVs. Ensure C2 continuity. **[10 marks]**
- Q.4. Find out at what values of u , the influence of (a) P_0 & P_1 AND (b) P_2 & P_3 is same on the Bezier curve in the range 0 to 1, defined by these control points. **[10 marks]**
- Q.5. Smooth path planning for a mobile robot is based on quadratic Bezier curve defined by three points, $P_0 [2,2]$, $P_1 [3,4]$ and $P_2 [4,3]$. **[10 marks]**
- a) Write parametric equation of the curve.
 - b) Draw a neat sketch of the curve.
 - c) Does this path exactly trace a circular arc? Derive and show the proof for your answer.