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### End Term Examination (December 2019)

School: School of Engineering

Program: M.Tech Bioengineering  
Biomedical Engineering

Course: Computer Aided Product Design

Course Code: BEN505

Semester: I

Max Marks: 40

Duration (mins): 90

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**A. Answer any THREE questions from the following: (24)**  
**(Each question carries 8 marks)**

1. A triangle PQR is represented as P (14,15), Q (66,15) and R (40,60). It is mirrored about line  $y=30$ . Determine the new coordinates of the triangle.
2. A cubic spline curve is defined by the equation  $P(u) = C_3u^3 + C_2u^2 + C_1u + C_0$ ,  $0 \leq u \leq 1$  where  $C_3$ ,  $C_2$ ,  $C_1$ , and  $C_0$  are the polynomial coefficients. Assuming these coefficients are known, find the four control points that define an identical Bezier curve.
3. The coordinates of four data points  $P_0$ ,  $P_1$ ,  $P_2$  and  $P_3$  are: (2,2,0), (2,3,0), (3,3,0) and (3,2,0) respectively. Find the equation of the Bezier curve and determine the coordinates of points on the curve for  $u = 0, 0.25, 0.5, 0.75$  and  $1.0$
4. The concatenated transformation of the graphics element consists of the following operations:
  - i. the rotation through  $120^\circ$  about Z-axis;
  - ii. the translation through 10 and -20 units along X and Y directions respectively and
  - iii. the rotation through  $30^\circ$  about X axis.

Write the homogeneous transformation matrices for the above operations and develop the concatenated transformation matrix, if the operations are done in above sequence.

Will the sequence of operations affect the end result?

**B. Write notes on any TWO of the following: (10)**

**(Each question carries 5 marks)**

5. Boundary Representation (B-rep) of solids and Constructive Solid Geometry (CSG) representation of solids
6. B-spline curves
7. P-diagram, FMEA and their linkage
8. Design for Reliability and Design for Manufacturability

**C. Explain Design of Experiments and describe any one type of DoE. (06)**

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