

Year: B. Tech III (Semester VI)

Subject Name: Scientific and Engineering Data Visualisation
Type of course: Minors (Virtual and Augmented Reality)

Subject Code: BTCO19654

Rationale:

- The student should be able to design principles and techniques for visualizing data.
- Practical experience building and evaluating visualization systems.
- Allow for project-based import Modules to identify, understand, analyze, prepare, and present effective visualizations on a variety of topics.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
3	0	2	4	60	25	15	30	20	150

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Content	Total Hrs
1	Visualisation - Scientific and engineering perspective - Impact of Visualisation in product design, an overview of computer graphics for visualisation –Types of data for visualisation, Introduction to tensors. role of pre-processor, solver and post processor in solving engineering problems. Overview of massive data visualisation: Simplification methods, Multi-resolution methods, External memory methods, Visual scalability	7
2	Scalar visualisation techniques: Visualisation Goals, Representation of mesh and results data, mapping analysis results to Visualisations, one dimensional, two dimensional and 3D Scalar fields - Element face colour coding - contour display - Isosurface techniques - Marching Cubes algorithm - Particle sampling	9
3	Visualisation of flow data: Visualisation mappings of flow data, Vector mapping - elementary icons - particle traces - streaklines, streamlines - stream ribbons and streamtubes - global icons - Tensor mappings - elementary icons - global icons.	9

4	Continuum volume display: Volume rendering Terminology, Surface and Volume rendering techniques, Optimisation	7
5	Applications of engineering visualisation: Case studies created in the laboratory. FUTURE TRENDS: Trends in Computing Hardware, Animation, Video and multi- media, software trends in Visualisation	10

Suggested Specification table with Marks (Theory): (For B.Tech only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	25	20	0	0	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

Sr No	Title of book /article	Author(s)	Publisher and details like ISBN	Publication Year / Publication Edition
1	Mathematical Foundations of Scientific Visualization, Computer Graphics and Massive Data Exploration	Torsten Möller and Bernd Hamann Robert D Russell	Springer Verlag Berlin Heidelberg	Latest Edition
2	Introduction to Scientific Visualisation	Helen Wright	Springer.	
3	Computer Visualisation: Graphics Techniques for Engineering and Scientific Analysis	Richard S Gallagher	CRC Press, CRC Press LLC	

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To design processes to develop visualisation methods and visualisation systems, and methods for their evaluation.	25%
CO-2	To complete preparation and processing of data, visual mapping and the visualisation	25%
CO-3	To analyse large-scale abstract data.	10%



CO-4	Apply mapping for visualisation of flow data	20%
CO-5	Infer the applications of Engineering Visualization	10%

List of Open learning website:

List of Open Source Software:

FOR LAB SESSIONS:

List of Experiments:

Sr. No	Practical
1.	Create different charts for data visualization.
2.	Search the web for good and bad examples visualizing 2D scalar fields. a. Pick one bad example and provide a critique listing some of its good merits and why you view it as a poor example of visualization. b. Pick a good example and explain why you believe it is a good visualization. List a couple of ways that it could be improved even further.
3.	Implement two of the basic (standard) representations using Vtk.
4.	Add 4-7 additional presentation elements that aid in understanding the visualization. These may include a title, a legend, axes, a skirt, grid lines, an interactive probe, multiple view layout, 3D camera controls, animation, backdrops or shadow boxes, drop pins, a nice background, separate back-face coloring, lighting controls, etc.
5.	Create the best visualization you can from above and provide a critique of it. What would you do if you had more time, etc.?
6.	Develop a rather novel (or artistic if you like) representation of the data, in either 2D or 3D
7.	Analyze data of a given dataset with formulas, functions, filters and ranges.
8.	Create conditional visualizations to analyze data.
9.	Perform Statistics Measures (Max, Min, Product, Count, Average, Standard deviation) in Pivot Table.
10.	Use the volume rendering capabilities of vtk to produce direct volume renderings : Design transfer functions 1. Generate MIP and Compositing based Volume Renderings 2. Explore different parameters which affects the Volume Rendering 3. Provide the level-of-detail for interaction 4. Allow the volume rendering occurring when there is no mouse input

Major Equipment Needed: NA

