Graphics and Visual Computing

1.1 Course Number: CS231

1.2 Contact Hours: 2-0-2 Credits: 8

1.3 Semester-offered: 2nd Year-Odd

1.4 Prerequisite: Data Structures and Discrete Structures

1.1 Syllabus Committee Member: Dr. Sushum Biswas, Dr. Daya Sagar Gupta & Dr. Gargi Srivastava

2. **Objective:** Detailed study of computer graphics, 2 D and 3 D transformations, representations and visualization.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Fundamentals of Computer Graphics and Graphics Primitives	Applications of computer Graphics in various Video Display Devices, Random scan displays, raster scan displays, DVST, Flat Panel displays, I/O Devices. Algorithms for drawing Line, circle, ellipse, arcs & sectors, Boundary Fill & Flood Fill algorithm, Color Tables	8
2	Transformations & Projections and Clipping	2D & 3D Scaling, Translation, rotation, shearing & reflection, Composite transformation, Window to Viewport transformation, Orthographic and Perspective Projections. CohenSutherland, Liang Barsky, Nicholl-Lee-Nicholl Line clipping algorithms, Sutherland Hodgeman, Weiler Atherton Polygon clipping algorithm.	8
3	Three Dimensional Object Representations	3D Modeling transformations, Parallel & Perspective projection, Clipping in 3D. Curved lines & Surfaces, Spline representations, Spline specifications, Bezier Curves & surfaces, B-spline curves & surfaces, Rational splines, Displaying Spline curves & surfaces.	8
4	Basic Rendering	Rendering in nature, Polygonal representation, Affine and coordinate system transformations, Visibility and occlusion, depth buffering, Painter's algorithm, ray tracing, forward and backward rendering equations, Phong Shading per pixel per vertex Shading.	8
5	Visualization	Visualization of 2D/3D scalar fields: color mapping, iso surfaces. Direct volume data rendering: ray-casting, transfer functions, segmentation. Visualization of: Vector	8

		fields and flow data, Time-varying data, High-dimensional data: dimension reduction, parallel coordinates, Non-spatial data: multi-variate, tree/graph structured, text Perceptual and cognitive foundations, Evaluation of visualization methods, Applications of visualization, Basic Animation Techniques like traditional, keyframing.	
		Total	**40**

4. Readings

4.1 Textbook:

Donald D Hearn, M. Pauline Baker, Computer Graphics C version, Pearson Education.

Dave Shreiner, Mason Woo, Jackie Neider, Tom Davis, OpenGL Programming Guide: The Official Guide to Learning OpenGL, (2013).

4.2 Reference books:

James D. Foley, Andries van Dam, Steven K. Feiner, John F. Hughes, Computer Graphics: Principles & Practice in C, Addison Wesley Longman.

Zhigang Xiang, Roy A Plastock, Computer Graphics, Schaums Outline, TMH.

5 Outcome of the Course:

On completion of this course, the students will be able to:

1. Comprehend the concepts related to basics of computer graphics and visualization.
2. Demonstrate various graphics primitives and 2-D, 3-D geometric transformations and clipping techniques.
3. Comprehend the concepts related to three dimensional object representations.
4. Implement various hidden surface removal techniques.
5. Demonstrate the use of OpenGL to create interactive computer graphics applications.