COMPUTER GRAPHICS AND VIRTUAL REALITY SYSTEMS				
CLASS T.E. (INFORMATION TECHNOLOGY)			SEMESTER V	
HOURS PER WEEK	LECTURES	:	04	
	TUTORIALS	:	--	
	PRACTICALS	:	02	
			HOURS	**MARKS**
EVALUATION SYSTEM:	THEORY		3	100
	PRACTICAL		--	25
	ORAL		--	25
	TERM WORK		--	25

1. **Introduction to Computer graphics and Image Analysis**
   Introduction, Image and Object, Image Representation, The basic graphics pipeline, Bitmap vs Vector based Graphics, Applications of Computer Graphics, Various Display Devices and Input Technology Overview of Coordinate System. Scan Conversion algorithm: Scan Conversion of a point, Scan conversion of lines, Digital differential analyzer algorithm, Bresenhams line drawing algorithm

2. **Two and Three Dimensional Transformations**
   Introduction, Transformation Matrix, Types of transformation, Translation, Rotation, Scaling, Reflection, Shear, Composite transformations, and Transformation function.

3. **Viewing and Clipping**
   Introduction ,Viewing transformation in two-dimensions, Introduction to clipping, 2D clipping, Point clipping, Line clipping, Cohen Sutherland line clipping, Midpoint subdivision algorithm, Cyrus Beck line clipping, Liang Barsky line clipping, Introduction to Polygon clipping, Sutherland Hodgeman polygon clipping, Weller Atherton algorithm, Viewing and clipping in 3D,Viewing transformation, Text clipping**,** Projection, Parallel projection, Orthographic projection, Oblique projection, Perspective projection ,One point perspective, Two point perspective, Three point perspective.

4. **Solid Area Scan Conversion**
   Introduction, Inside Outside test, Winding number method, Coherence, Polygon filling, Seed fill algorithm, Boundary fill algorithm, Flood fill algorithm, Scan line algorithm, Priority algorithm, Scan conversion of characters, Anti aliasing, Types of anti aliasing, Haftoning, thresholding and dithering

5. **Curve Design :**
   Introduction, Curve continuity, Conic curves, Piecewise curve design, LeGrange interpolated curves, Spline curve representation, Bezier Curves, B Spline Curves, Non Uniform Rational B Spline curves, Introduction to fractal and introduction color models.

6. Computer Animation

Introduction, Key Frame Animation, Construction of an animation sequence, Motion control methods, Methods based on geometric and kinematics information, Methods based on physical information, Methods based on Behavioral Information, Procedural Animation, Introduction to Morphing, Intermediate Images, Mapping orders, Warping techniques, Mesh warping, Feature based image warping, Thin plate Spline, TPS based image warping, 3D morphing.

7. Introduction to Virtual Reality

A short history of early virtual reality, early commercial VR Technology, The five classical components of VR Systems, Design of Virtual reality systems, Important factors in VR systems, Types of VR systems, Advantages of virtual reality .

8. Input and Output Devices

Three Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces, Graphical Display, Sound displays, and Haptic Feedback.

9. Computing Architectures for Virtual Reality

The Rendering Pipeline: The graphical rendering pipeline, The haptics rendering pipeline, PC Graphics Architectures: Pc Graphics Accelerators, Graphics Benchmarks, Work Station Based Architectures: the Sun Blade 1000 Architecture, the SGI Infinite Reality Architecture, Distributed VR Architectures: Multipipeline Synchronization, Collocated rendering Pipelines, Distributed Virtual Environments.

10. Modeling

Geometric Modeling: Virtual Object Shape, Object Visual Appearance.

Kinematics Modeling: Homogeneous Transformation Matrices, Object Position, Transformation Invariants, Object Hierarchies, viewing the three dimensional words.

Physical Modeling: Collision Detection, Surface Deformation, Force Computation, Force Smoothing and Mapping, Haptic Texturing.

Behavior Modeling and Model Management: Level of Detail Management, Cell Segmentation.

11. Virtual Reality Programming

Toolkits and Scene Graphs.World Toolkit: Model Geometry and Appearance, the WTK Scene Graph, Sensors and Action Functions, WTK Networking,

JAVA 3D: Model Geometry and Appearance, Java 3D Scene graph, Sensors and Behaviors, Java 3D Networking, WTK and Java 3D Performance Comparison.

General Haptics Open Software Toolkit: GHOST Integration with the Graphics Pipeline, The GHOST Haptic Scene Graph, Collision Detection and response, Graphics and PHANToM Calibration.

12. Application areas of Virtual Reality

Medical, Education, Arts and Entertainment, Military, Manufacturing, Robotics, Information Visualization.

Text Books

1. R. K Maurya, "Computer Graphics", Wiley India.
2. Donal Hearn and M. Pauline Baker, "Computer Graphics", Pearson Education.
3. Newman and Sproll, "Principles of Interactive Computer Graphics", McGraw Hill.
4. Harrington, "Computer Graphics", McGraw Hill.
5. Rogers, "Procedural Elements of Computer Graphics", Tata McGraw Hill.
6. Vince, "Virtual Reality Systems", Pearson Education.
7. Grigore Burdea, Philippe Coiffet, "Virtual Reality Technology", 2nd edition. Wiley.

Term Work

Term work shall consist of at least 10 practical experiments covering all topics and one written test.

Marks

Distribution of marks for term work shall be as follows:

1. Attendance (Theory and Practical) 05 Marks
2. Laboratory work (Experiments and Journal) 10 Marks
3. Test (at least one) 10 Marks

The final certification and acceptance of Term Work ensures the satisfactory Performance of laboratory Work and Minimum Passing in the term work.

Suggested Experiment List

1. Bresenham line drawing algorithm
2. 2D Transformation
3. 3D Transformation
4. Line Clipping Algorithm (Cohen - Sutherland & Liang - Barsky)
5. Polygon Clipping Algorithms
6. Projections
7. Polygon Filling Algorithms
8. Generation of 2D Curves
9. Fractals
10. Various Operations on Image such Morphing, Mapping, Warping etc.
11. Study of VR Architectures
12. Designing a Virtual Model (Geometric, Kinematics etc.)
13. VR Programming using toolkits