



SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and
Technology
Bachelor of Technology



Year: B. Tech II (Semester IV)

Subject Name: Computer Graphics for Virtual Reality
Type of course: Minor (Group: Virtual and Augmented Reality)
Prerequisite (if any):

Subject Code: BTCO19454

List of Courses where this course will be prerequisite:

Rationale:

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	Graphics system and models: applications of computer graphics, graphics system, physical and synthetic images, imaging systems, graphics architectures.	5
2	Geometric objects and transformations: scalars, points and vectors, three-dimensional primitives, coordinate systems and frames, frames in OpenGL, matrix and vector classes, modelling a colored cube, affine transformations - translation, rotation and scaling, transformations in homogeneous coordinates, concatenation of transformations, transformation matrices in OpenGL, interfaces to 3D applications, quaternion. Vertices to fragments: basic implementation strategies, four major tasks, clipping - line clipping, polygon clipping, clipping of other primitives, clipping in three dimensions, polygon rasterization, hidden-surface removal, antialiasing, display considerations.	10





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3	<p>Lighting and shading: light and matter, light sources, the Phong reflection model, computation of vectors, polygonal shading, approximation of a sphere by recursive subdivision, specifying lighting parameters, implementing a lighting model, shading of the sphere model, per-fragment lighting, global illumination.</p> <p>Hierarchical modelling: symbols and instances, hierarchical models, a robot arm, trees and traversal, use of tree data structures, other tree structures, scene graphs, open scene graph.</p>	10
4	<p>Discrete techniques: buffers - digital images - writing into buffers - mapping methods - texture mapping - texture mapping in OpenGL - texture generation - environment maps - reflection map - bump mapping - compositing techniques - sampling and aliasing.</p> <p>Advanced rendering: going beyond pipeline rendering - ray tracing - building a simple ray tracer - the rendering equation - radiosity - Renderman - parallel rendering - volume rendering - Isosurfaces and marching cubes - mesh simplification - direct volume rendering - image-based rendering.</p>	10
5	<p>Fractals: modelling - Sierpinski Gasket - coastline problem - fractal geometry - fractal dimension - recursively defined curves - Koch curves - c curves - dragons - space filling curves - turtle graphics - grammar based models - Graftals - volumetric examples - k-midpoint subdivision - fractal Brownian motion - fractal mountains - iteration in the complex plane - Mandelbrot set.</p> <p>Virtual reality modelling language: introduction, exploring and building a world, building object, lighting, sound and complex shapes, animation and user interaction, colors, normals and textures, nodes references.</p> <p>Special applications: stereo display programming, multiport display systems, multi-screen display system, fly mode navigation, walk through navigation, virtual track ball navigation.</p>	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.





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Reference Books:

Sr No	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1	Computer Graphics with Virtual Reality System,	Rajesh K. Maurya,	John Wiley & Sons		
2.	Interactive Computer Graphics: A Top-Down Approach Using OpenGL	Edward Angel,	Addison-Wesley		
3.	Computer Graphics: Principles and Practice	Foley James D, Van Dam, Feiner and Hughes	Pearson Education.		
4	Computer Graphics C Version	Donald Hearn and Pauline Baker	Pearson Education.		

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To list the basic concepts used in computer graphics.	15
CO-2	To implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.	35
CO-3	To define the fundamentals of animation, virtual reality and its related technologies.	35
CO-4	To design an application with the principles of virtual reality	15

List of Open learning website:

- <https://www.opengl.org/>



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List of Open Source Software:

- OpenGL, X3D

FOR LAB SESSIONS:

List of Experiments:

Sr. No	Practical
1.	Study and enlist the basic functions used for graphics in C / C++ language. Give an example for each of them.
2.	Develop the program for DDA Line drawing algorithm.
3.	Develop the program for Bresenham's Line drawing algorithm.
4.	Perform the following transformation on the triangle Translation Scaling Rotation
5.	Program to create a house like figure and perform the following operations. i. Scaling about the origin followed by translation. ii. Scaling with reference to an arbitrary point. iii. Reflect about the line $y = mx + c$.
6.	Write a program to fill a circle using any standard method
7.	Write a program to implement Cohen Sutherland line clipping algorithm
8.	Write a program to implement Liang - Barsky Line Clipping Algorithm
9.	Write a program for moving car on screen
10.	To study OpenGL library and implement various functions available in OpenGL library
11.	Draw Simple 2D colored Shapes: quad, triangle and polygon.
12.	Write a Program for bouncing ball inside the window using OpenGL library
13.	Implement OpenGL examples showing how to do hardware lighting including two-sided lighting.





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14.	Write a program demonstrating the use of the GL lighting model.
15.	Experiments on Lighting and shading of 2D and 3D objects
16.	Experiment on Fractals
17.	Experiments on Virtual reality modelling language

