Computer Graphics	Code & No:	CS 310
	Credits:	3 (3,0,1)
	Pre-requisite:	CS 120
	Co-requisite:	None
	Level:	7

Course Description:

This course will provide basic techniques on computer graphics, including software, hardware and applications. This course assumes good background in programming using C or C++, mathematics and linear algebra. Major topics include introduction to basic computer graphics, 2D and 3D transformations, curve modeling, and illumination and surface rendering approaches. Concepts and graphics algorithms will be reinforced using standard application program interface (e.g. OpenGL).

Course Aims:

The aim of this course is to allow students to acquire knowledge of understanding Computer Graphics Systems, specifically;

1. The fundamental display algorithms for raster graphics systems
2. The mathematical nature of 2- and 3-D environments
3. The properties of surfaces and their simulation

Student Outcomes (SOs):

☒(a) An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline

☒(b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution

☒(c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs

☐(d) An ability to function effectively on teams to accomplish a common goal

☐(e) An understanding of professional, ethical, legal, security and social issues and responsibilities

☐(f) An ability to communicate effectively with a range of audiences

☐(g) An ability to analyze the local and global impact of computing on individuals, organizations, and society

☐(h) Recognition of the need for and an ability to engage in continuing professional development

☒(i) An ability to use current techniques, skills, and tools necessary for computing practice.

☒(j) An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices. [CS]

☐(k) An ability to apply design and development principles in the construction of software systems of varying complexity. [CS]

☐(j) An ability to use and apply current technical concepts and practices in the core information technologies of human computer interaction, information management, programming, networking, and web systems and technologies. [IT]

☐(k) An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation, and administration of computer-based systems. [IT]

☐(l) An ability to effectively integrate IT-based solutions into the user environment. [IT]

☐(m) An understanding of best practices and standards and their application. [IT]

☐(n) An ability to assist in the creation of an effective project plan. [IT]

Course Learning Outcomes (CLOs):

1. Understand the foundations of computer graphics: hardware systems, math basis, light and color.
2. Implement key components of the rendering pipeline, especially visibility, characterization, viewing, and shading to understand issues involved in implementing other components.
3. Evaluate the complexities of modeling realistic objects through modeling complex scenes using a high-level scene description language.
4. Identify some advanced topics in computer graphics; these might include texturing, animation, physically-based modeling, procedural modeling, curves and surfaces, global illumination, interaction, visualization, and virtual reality.

SOs and CLOs Mapping:

CLO/SO	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CLO1	√													
CLO2			√						√					
CLO3		√	√							√				
CLO4			√						√	√				

No.	Topics	Weeks	Teaching hours
1	Introduction and applications of Computer Graphics	2	6
2	Scan-Conversion: Scan-Converting A Point, Scan-Converting A Straight Line: DDA Line Algorithm, Bresenham's Line Algorithm, Scan-Converting a Circle and an Ellipse: Mid-Point Circle and Ellipse Algorithm	2	6
3	Two –Dimensional & Three Dimensional Transformations: Two –dimensional translation, rotation, scaling, reflection, shear transforms, Two-dimensional composite transformation	2	6
4	Two –Dimensional & Three Dimensional Transformations: Two-dimensional viewing pipeline, world to screen viewing transformations and clipping (Cohen-Sutherland Line Clipping, Liang-Barsky Line Clipping), Three –dimensional translation, rotation, scaling, reflection, shear transforms	2	6
5	Two –Dimensional & Three Dimensional Transformations: Three-dimensional composite transformation, Three-dimensional viewing pipeline, world to screen viewing transformation, projection concepts (orthographic, parallel, perspective projections)	2	6
6	Curve Modeling: Introduction to Parametric cubic Curves, Splines, Bezier curves	2	6
7	Illumination and Surface Rendering methods: Algorithms to simulate ambient, diffuse and specular reflections, Constant , Gouraud and phong shading models	2	6
	Total	**14**	**42**

Textbook:

- Hearn, Donald, and M P. Baker. Computer graphics with OpenGL. Boston: Addison Wesley, 2011.

Essential references:

- Real-Time Rendering, Akenine-Moller, Haines, 3rd edition, AK Peters Ltd, 2008.
- Fundamentals of Computer Graphics, Shirley, Ashikhmin, Marschner, A K Peters, 2009.
- Computer Graphics: Principles and Practice, Foley, Addison-Wesley, 4th edition, 2015
- Computer Graphics: Using OpenGL, Hill, 2nd edition, Prentice Hall, 2001.