ITM(SLS) Baroda University
School of Computer Science, Engineering and Technology
B.Tech – Semester II

Course Name: Computer Graphics
Course Code:C2210C3
Course Type: Core

Teaching Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				External	Internal	External	Internal	
4	0	2	5	40	60	20	30	150

About Computer Graphics:

Computer graphics is a sub-field of computer science which studies methods for digitally synthesizing and manipulating visual content. Although the term often refers to the study of three-dimensional computer graphics, it also encompasses two-dimensional graphics and image processing.

Basically there exists two kinds of computer graphics - raster (composed of pixels) and vector (composed of paths). Raster images are more commonly called bitmap images. A bitmap image uses a grid of individual pixels where each pixel can be a different color or shade.

The importance of computer graphics lies in its applications. Interactive computer graphics allows the physician to interpret this large volume of data in new and useful ways. Computer graphics has also expanded the boundaries of art and entertainment.

Course Overview:

In this course the students will learn about the concepts of computer graphics. It starts with an overview of interactive computer graphics, two dimensional system and mapping, then it presents the most important drawing algorithm, two-dimensional transformation; Clipping, filling and an introduction to 3-dimensional graphics.

Prerequisite:

This course does not require any programming background. This course helps the students to learn programming in python.

Course Outcome :

At the end of the course the student will be able to:

CO's	Course Outcome	Bloom Taxonomy Level
CO1	Understand Random and Raster scan systems, Graphics software and standards	Remember
CO2	Demonstrate Points, lines, circles and ellipses as graphics primitives	Understanding
CO3	Illustrate Fill area primitives including scan-line polygon filling	Understanding
CO4	Ability to draw basic 2-D geometric shapes	Applying
CO5	Ability to apply various 2-D transformations on geometric shapes	Applying
CO6	Ability to draw simple 3-D geometric shapes	Applying
CO7	Understand 3-D transformations and projections	Understanding
CO8	Demonstrate Points, lines, and polygon clippings	Applying

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15	PO16
CO1	1	3		3	3	3	2	2		1	1	1	2	3	1	3
CO2	2	3	3	3	1	1	2	2	1				2	3	1	3
CO3	3	3	3	3	3	3	2	3	2	2	2	1	2	3	2	2
CO4	1	3	3	3	3	3	3	2	2		1			3	1	2
CO5	1	3	3	3	3	2	1	2	1			1	2	2		2
CO6	2	1	1	3	3	1	1	2			2			2		1
CO7	1	1	2	1	2	1	2	1	1			1		2	1	
CO8	2		1	3	1	3	1	1	2		1		2		2	

Course Outline :

Unit #	Topics	Hours L+P
1	**Basic of Computer Graphics**: Basic of Computer Graphics: Coordinate Systems, Graphics APIs; Display devices, Random and Raster scan systems, Graphics software and standards; Color models: properties of light, XYZ, RGB, YIQ and CMY color models	8 + 2
2	**Graphics Primitives**: Points, lines, circles and ellipses as primitives, scan conversion algorithms for primitives, Fill area primitives including scan-line polygon filling, inside-outside test, boundary and flood-fill	10+10
3	**2D transformation and viewing**: Transformations (translation, rotation, scaling), matrix representation, homogeneous coordinates, composite transformations, reflection and shearing, viewing pipeline and coordinates system, window-to-viewport transformation, clipping including point clipping, line clipping (cohen-sutherland, liang- bersky, NLN), polygon clipping	10+10
4	**3D concepts and object representation**: 3D display methods, polygon surfaces, meshes, curved lies and surfaces, quadric surfaces, spline representation, cubic spline interpolation methods	10 + 8
5	**3D transformation and viewing**: 3D scaling, rotation and translation, composite transformation, parallel and perspective transformation, projection transformations	7 + 0
	Total	**45+30**

Reference :

Text Book :

1. Donald D. Hearn, M. Paulin Baker, & Warren Carithers, “Computer Graphics, with OpenGL”, Pearson Education
2. Sinha, Udai, “Computer Graphics”, Tata McGraw-Hill

Reference Books:

1. Foley, van Dam, “Computer Graphics”, Pearson Education
2. Francis S Hill, Jr. and Stephen M Kelley, “Computer Graphics Using OpenGL”, Prentice Hall
3. Peter Shirley, “Fundamentals of Computer Graphics”, A K Peters, 2009

Learning Resources:

SR.No	TEDx Video
T1	https://www.ted.com/talks/danielle_feinberg_the_magic_ingredient_that_brings_pixar_movies_to_life **Danielle Feinberg**, **Pixar's director of photography:** He creates stories with soul and wonder using math, science and code. Go behind the scenes of Finding Nemo, Toy Story, Brave, WALL-E and more, and discover how Pixar interweaves art and science to create fantastic worlds where the things you imagine can become real. This talk comes from the PBS special "TED Talks: Science & Wonder."
T2	https://www.youtube.com/watch?v=6hfOvs8pY1k **Animation basics: The art of timing and spacing - TED-Ed - David J. Malan** Expert timing and spacing is what separates a slide show from a truly amazing animation. TED-Ed demonstrates, by manipulating various bouncing balls, how the smallest adjustments from frame to frame can make all the difference. Lesson and animation by TED-Ed.

Other Videos:

Sr. No	About Video	Link	Topic
01.	Ken Joy is a Professor in thecomputer science department at the University of California at Davis.He has worked a number of years in the computer industry, and consults regularly on visualization, massive data analysis and geometric modeling.	https://www.youtube.com/watch?v=01YSK5gIEYQ&list=PL_w_qWAQZtAZhtzPI5pkAtcUVgmzdAP8g&index=1	Preliminary background into some of the math associated with computer graphics.
02.	This complimentary course, originally presented at the SIGGRAPH 2013 conference	https://www.youtube.com/watch?v=6-9XFm7XAT8	Introduction to programming OpenGL, emphasizing the most modern methods for using the library
03.	David E. Breen is currently an Associate Professor of Computer Science in the College of Computing and Informatics of Drexel University.	https://www.youtube.com/watch?v=RDUH2412ZU0	In this talk I will introduce level set models and describe four computer graphics applications that utilize them. The applications are 3D morphing, contour-based surface reconstruction, volume segmentation and geometric modeling.
04.	Texas State Technical University	https://www.youtube.com/watch?v=zG6j0be2E-0	The Graphics, Gaming & Simulation specialization of Computer Science Technology is designed to prepare students for entry into the world of graphics programming.
05.	James Abell , an artist and designer based in Scotland. He mix art, and traditional sculptures with digital technique.	https://www.youtube.com/watch?v=seQuqguSiko	This video talks about the building blocks of 3d graphics. I talk about how they are worked out using the X/Y/Z axis. I then talk about primitives and then sub object modelling using the vertices/edges and polygons.

Related MOOCs courses

SR.No	MOOC Courses
M1	https://nptel.ac.in/courses/106/102/106102063/
M2	https://nptel.ac.in/courses/106/102/106102065/
M3	https://nptel.ac.in/courses/106/103/106103224/
M4	https://www.edx.org/course/foundations-computer-graphics-uc-berkeleyx-cs-184-1x
M5	https://www.edx.org/course/computer-graphics-2
M6	https://www.coursera.org/learn/interactive-computer-graphics
M7	https://www.coursera.org/learn/geometric-algorithms
M8	https://www.udemy.com/course/graphics-with-modern-opengl/
M9	https://www.udemy.com/course/graphics-in-c/
M10	https://onlinecourses.nptel.ac.in/noc20_cs90/preview

Lab Experiments:

SR.NO	Program Statement
P1	Draw a line using Digital Differential Analyzer Line Algorithm [DDA]
P2	Draw a line using Bresenham's line drawing algorithm
P3	Draw a Circle using Bresenham's circle drawing algorithm
P4	Draw a Circle using Mid Point circle drawing algorithm
P5	Demonstrate Boundary Fill Algorithm
P6	Demonstrate Flood Fill Algorithm
P7	Demonstrate Two Dimensional Transformations
P8	Demonstrate Two Dimensional Composite Transformations
P9	Illustrate Cohen Sutherland Algorithm for a line clipping
P10	Illustrate Sutherland Hodgman Algorithm for a polygon clipping

Case Studies:

SR.No	Titles	Evaluation Parameters for All
C1	Google Sketch up	Identification of software Analysis and working methodology Output and result accuracy evaluation Report preparation Presentations
C2	FRASCA flight simulator	
C3	INTERSECTSimulator	
C4	Open Sees	
C5	HEC-RAS	