

Course Code	Course Name	Credits
CSC305	Computer Graphics	3

Prerequisite: Knowledge of C Programming and Basic Mathematics.

Course Objectives

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| 1 | To equip students with the fundamental knowledge and basic technical competence in the field of Computer Graphics. |
| 2 | To emphasize on implementation aspect of Computer Graphics Algorithms. |
| 3 | To prepare the student for advance areas and professional avenues in the field of Computer Graphics |

Course Outcomes: At the end of the course, the students should be able to

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| 1 | Describe the basic concepts of Computer Graphics. |
| 2 | Demonstrate various algorithms for basic graphics primitives. |
| 3 | Apply 2-D geometric transformations on graphical objects. |
| 4 | Use various Clipping algorithms on graphical objects |
| 5 | Explore 3-D geometric transformations, curve representation techniques and projections methods. |
| 6 | Explain visible surface detection techniques and Animation. |

Module		Detailed Content	Hours
1		Introduction and Overview of Graphics System:	02
	1.1	Definition and Representative uses of computer graphics, Overview of coordinate system, Definition of scan conversion, rasterization and rendering.	
	1.2	Raster scan & random scan displays, Architecture of raster graphics system with display processor, Architecture of random scan systems.	
2		Output Primitives:	10
	2.1	Scan conversions of point, line, circle and ellipse: DDA algorithm and Bresenham algorithm for line drawing, midpoint algorithm for circle, midpoint algorithm for ellipse drawing (Mathematical derivation for above algorithms is expected)	
	2.2	Aliasing, Antialiasing techniques like Pre and post filtering, super sampling, and pixel phasing).	
	2.3	Filled Area Primitive: Scan line Polygon Fill algorithm, inside outside tests, Boundary Fill and Flood fill algorithm.	
3		Two Dimensional Geometric Transformations	6
	3.1	Basic transformations: Translation, Scaling, Rotation	
	3.2	Matrix representation and Homogeneous Coordinates	
	3.3	Composite transformation	
	3.4	Other transformations: Reflection and Shear	
4		Two-Dimensional Viewing and Clipping	7
	4.1	Viewing transformation pipeline and Window to Viewport coordinate transformation	
	4.2	Clipping operations: Point clipping, Line clipping algorithms: Cohen-Sutherland, Liang: Barsky, Polygon Clipping Algorithms: Sutherland-Hodgeman, Weiler-Atherton.	
5		Three Dimensional Geometric Transformations, Curves and Fractal Generation	8
	5.1	3D Transformations: Translation, Rotation, Scaling and Reflection	

	5.2	Composite transformations: Rotation about an arbitrary axis	
	5.3	Projections – Parallel, Perspective. (Matrix Representation)	
	5.4	Bezier Curve, B-Spline Curve, Fractal-Geometry: Fractal Dimension, Koch Curve.	
6		Visible Surface Detection and Animation	6
	6.1	Visible Surface Detection: Classification of Visible Surface Detection algorithm, Back Surface detection method, Depth Buffer method, Area Subdivision method	
	6.2	Animation: Introduction to Animation, Traditional Animation Techniques, Principles of Animation, Key framing: Character and Facial Animation, Deformation, Motion capture	

Textbooks:

- 1 Hearn & Baker, "Computer Graphics C version", 2nd Edition, Pearson Publication
- 2 James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice in C", 2nd Edition, Pearson Publication
- 3 Samit Bhattacharya, "Computer Graphics", Oxford Publication

References:

- 1 D. Rogers, "Procedural Elements for Computer Graphics", Tata McGraw-Hill Publications.
- 2 Zhigang Xiang, Roy Plastock, "Computer Graphics", Schaum's Outlines McGraw-Hill Education
- 3 Rajesh K. Maurya, "Computer Graphics", Wiley India Publication.
- 4 F. S. Hill, "Computer Graphics using OpenGL", Third edition, Pearson Publications.

Assessment:

Internal Assessment:

Assessment consists of two class tests of 20 marks each. The first-class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

- 1 Question paper will comprise of 6 questions, each carrying 20 marks.
- 2 The students need to solve total 4 questions.
- 3 Question No.1 will be compulsory and based on entire syllabus.
- 4 Remaining question (Q.2 to Q.6) will be selected from all the modules

Useful Links

- 1 <https://www.classcentral.com/course/interactivegraphics-2067>
- 2 https://swayam.gov.in/nd2_ntr20_ed15/preview
- 3 <https://nptel.ac.in/courses/106/106/106106090/>
- 4 <https://www.edx.org/course/computer-graphics-2>

Course Code	Lab Name	Credits
CSL303	Computer Graphics Lab	1

Prerequisite: C Programming Language.

Lab Objectives:

- 1 Understand the need of developing graphics application
- 2 Learn algorithmic development of graphics primitives like line, circle, polygon etc.
- 3 Learn the representation and transformation of graphical images and pictures

Lab Outcomes: At the end of the course, the students should be able to

- 1 Implement various output and filled area primitive algorithms
- 2 Apply transformation, projection and clipping algorithms on graphical objects.
- 3 Perform curve and fractal generation methods.
- 4 Develop a Graphical application/Animation based on learned concept

Content:

Scan conversions: lines, circles, ellipses. Filling algorithms, clipping algorithms. 2D and 3D transformation Curves Visible surface determination. Simple animations Application of these through exercises in C/C++

List of Suggested Experiments:

Sr. No.	Name of the Experiment
1	Implement DDA Line Drawing algorithm (dotted/dashed/thick)
2	Implement Bresenham's Line algorithm(dotted/dashed/thick)
3	Implement midpoint Circle algorithm.
4	Implement midpoint Ellipse algorithm.
5	Implement Area Filling Algorithm: Boundary Fill, Flood Fill.
6	Implement Scan line Polygon Filling algorithm.
7	Implement Curve: Bezier for n control points, B Spline (Uniform)(at least one)
8	Implement Fractal generation method (anyone)
9	Character Generation: Bit Map method and Stroke Method
10	Implement 2D Transformations: Translation, Scaling, Rotation, Reflection, Shear.
11	Implement Line Clipping Algorithm: Cohen Sutherland / Liang Barsky.
12	Implement polygon clipping algorithm (at least one)
13	Program to perform 3D transformation.
14	Perform projection of a 3D object on Projection Plane: Parallel and Perspective.
15	Perform Animation (such as Rising Sun, Moving Vehicle, Smileys, Screen saver etc.)

Term Work:

- 1 Term work should consist of 10 experiments.
- 2 Journal must include at least 2 assignments
- 3 Mini Project to perform using C /C++/Java/OpenGL/Blender/ any other tool (2/3 students per group). Possible Ideas: Animation using multiple objects, Game development, Graphics editor: Like Paint brush, Text editor etc.
- 4 The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work.
- 5 Total 25 Marks (Experiments: 10-marks, Attendance Theory& Practical: 05-marks, Assignments: 05-marks, Mini Project: 5-marks)

Oral & Practical exam

Based on the above contents and entire syllabus of CSC305