

Salisbury University Department of Mathematical Sciences

**MATH/COSC 482/582 : Computer Graphics
Syllabus (Tentative)**

Description: Generate and manipulate graphic information using the computer. Emphasis on the analysis of fundamental problems associated with these activities and on the structured design of solutions. 4 Hours Credit: Meets four hours per week.

Prerequisites: C or better in COSC 120, MATH 293 or MATH 306.

Credit: Credit may only be received for one of COSC 482, COSC 582, MATH 482, and MATH 582.

Intended Audience: Majors in Mathematics or Computer Science as well as strong minors in mathematics or computer science who wish to understand the mathematics and implementations of both real-time and ray-tracing graphics systems.

Objective: At the conclusion of the course, the student will have demonstrated (a) ability to design, and implement on a computer, algorithms to display and manipulate elementary two- and three-dimensional graphics figures and (b) understanding of the mathematics underlying those activities.

Textbooks: *Open GL Programming Guide: The Official Guide To Learning Open GL, Version 4.3*, The Kronos OpenGL ARB Working Group, Dave Shreiner et.al., Pearson Education, 8th edition, 2013.

Technology: C++ will be the implementation language along with open OpenGL API and the GLSL shading language. Other systems may include the SFML windowing system, event-driven programming, and the GLM and GLEW libraries.

Topic	Weeks
Introduction	1
Conceptual framework for graphics programming. The graphics and shader pipelines, and ray tracing systems. Introduction to the OpenGL API and the GLSL shading language, GLEW, SFML and an introduction to a ray tracing system.	
Graphics Primitives and Techniques	3
Color, basic modeling, single vs. double buffering, hidden surface removal, clipping, and event driven programming, GLSL basics, creating and loading shaders, vertex arrays and data transfer to graphics device, graphical client-server model and parallel processing via shaders.	
Lighting, Illumination, and Shading	2
Lighting models, materials, shading vs. shadowing, coding lighting models in GLSL, intermediate modeling techniques, normal vector calculations.	
Geometrical Transformations and Viewing	3
Coordinate-free geometry, linear and affine spaces, homogeneous coordinates, change in frames, translations, scaling, rotations, shear, combinations of transformations, an introduction to animation, matrix stacks, modeling and projection matrices, coding transformations and matrix manipulation in GLSL. Ray tracing commands for geometric transformations.	
Texture Mapping and Blending	3
Texture mapping, bump mapping, environment mapping. Texture coordinates, texture coordinate generation and texture transformations. Blending modes, color space transformations, and the alpha channel, coding textures and blending in GLSL. Ray tracing texture modes, bump mapping and transparency.	
Advanced Techniques of Three-Dimensional Graphics	1
Bezier curves, advanced modeling, intersection and collision testing, incorporation of a physics engine, radiosity, alternative lighting models, reflection and shadowing.	
Exams and/or Optional Topics	1
Total	14

Evaluation

Exams, Quizzes, Programs	40 – 80%
Final Exam and Final Project(s)	20 – 60%

- Graduate students will be assigned special homework/test problems or projects.
- Clear descriptions of thought processes, evidence of critical thinking, and effective communication must be demonstrated in written work.
- **Writing Across the Curriculum:** Students will be expected to communicate mathematics and mathematical ideas effectively in speech and writing. At the University Writing Center, trained consultants are ready to help you at any stage of the writing process. In addition to the important writing instruction that occurs in the classroom and during professors' office hours, the Center offers another site for learning about writing. **All students are encouraged to make use of these important services.**
- **NOTE:** Once a student has received credit, including transfer credit, for a course, credit may not be received for any course with material that is equivalent to it or is a prerequisite for it.