Syllabus:

1. Course Title, Prerequisites, and Description:
Advanced Digital Cinematography, 5 credits
Prerequisites: ARTS COL 752 and graduate standing

This course provides a study of advanced issues and mathematical models used in computer graphics to mimic the physical behavior of light and appearance of surfaces in the generation of three-dimensional CG imagery.

2. Course Objectives and/or Student Learning Outcomes:
The generation of compelling synthetic imagery is primarily dependent upon two issues in computer graphics: the geometric shape of objects in the digital world and the illumination of those objects. This course will concentrate on the latter concern. Students will learn the mathematics and physics behind the simulation of light, texture, and form in computer graphics, and apply that knowledge by writing their own RenderMan shaders. Students will be encouraged to explore a broad range of styles, from photorealistic, to painterly, to cartoon-style.
Students will also gain necessary skills and experience to produce customized light and shading models, which provide aesthetic possibilities not available in "off-the-shelf" packages.

3. Course Methodology:
The course will attempt to survey the important issues surrounding the creation of virtual lights and the surfaces they illuminate in digital environments. The different types of lighting and surfaces employed in computer graphics, as well as their respective effects, will be examined. Images illustrating different lighting approaches will be shown whenever possible, but students will learn primarily by creating and lighting their own objects and environments. The class format will take on a variety of styles as the disparate subjects dictate. Examples will be presented in lectures and demonstrations. Students will present their images in critique sessions.

Students must demonstrate satisfactory achievement of course objectives through fulfillment of course projects and by contributing to class discussions and critiques. Course projects will require students to use a wide variety of software and equipment at ACCAD to produce images and shaders. Collaboration between students in the course and other faculty, staff and students at ACCAD is encouraged. Course evaluation will be based on the following:

Projects one through five:	12% each
Final Project:	30%
Class Participation:	10%

4. Grading Policy:
All students are required to be on time and in attendance for each and every class. Students arriving to class more than 10 minutes late will be counted as absent. Two absences will lower a final grade by 1/3 a letter, three absences will lower a final grade by one letter and four absences will result in failure of the course.

Adherence to deadlines is expected. It is the individual student's responsibility to keep track of deadlines and to present the work to the class and instructor on the specified dates. 15% per day will be subtracted from late assignments.

Students choosing to use "at home" hardware and software must have their current working files on the system and available for review at the beginning of each and every class. Problems with home systems and/or incompatibility will not be an acceptable excuse for missed goals. Technical problems will happen frequently during the semester and students will have trouble accessing the computer lab during "prime time" hours. Students must make their own arrangements for overcoming these difficulties and submitting their work on time. Unless there is a complete system failure in a computer-related course, technical difficulties are never an acceptable excuse for not meeting a deadline. Students should plan their time and work so as to anticipate the technical hurdles that are a part of this profession.

Academic Misconduct (rule 3335-31-02) is defined as "any activity which tends to compromise the academic integrity of the institution, or subvert the educational process." Please refer to rule 3335-31-02 in the student code of conduct for examples of academic misconduct.

To register a documented disability, please call the Office of Disability Services (located in 150 Pomerene Hall) at 292-3307; or 292-0901 TDD, and notify the professor.

If this course is taught in the evening, student escort service is available via 292-3322.

5. Topics and Assignments:
Topics:
1. Rendering Environment
   a. RenderMan
   b. Shader Language Introduction, RmanNotes
   c. Functions
   d. Readings: section 2.1, chapter 7
2. Shapes and Patterns
   a. Syntax, Tiling, Shapes, Booleans
   b. Layering, Pattern Generation
   c. Texturing, Bump/Displacement map intro
   d. Critique Assignment 1
   e. Readings: sections 8.1, 10.1-2
3. Irregular and Organic Attributes
   a. Noise, Turbulence
   b. Bombing
   c. Critique Assignment 2
   d. Readings: sections 10.3-5
4. Intro Surface Construction Software
   a. RAT: Slim
   b. Shadows, Environment Mapping
   c. Critique Assignment 3
5. Maya / RenderMan Integration
   a. Layering, attribute animation, projections
   b. Illumination ModelsVector math for illumination
   c. Uberlights
6. Advanced Lighting
   a. Global Illumination
   b. Area Lights
   c. Photon mapping
   d. Image-based lighting
   e. Critique Assignment 4
7. Advanced Surface Form and Light Control
   a. Displacement shaders
   b. Anti-aliasing
   c. Light shaders
   d. Readings: sections 8.2, 9, 11
8. Volume Representation
   a. 2D/3D Spaces
   b. Solid patterns
   c. Hypertextures
   d. Critique Assignment 5
   e. Readings: sections 12.4-6, 15
9. Non-Photorealistic Rendering (NPR)
   a. Introduction
   b. Simulating Flat Media

   c. Particle-based
   d. Readings: sections 12.8, 16
  10. Real-time Procedural Shading
   a. Hardware
   b. OpenGL and DirectX
   c. Compilers

Assignments:
1. Shader Basics
2. Regular Patterns
3. Irregular Patterns
4. Maya and RAT integration
5. Displacement and Illumination
6. Final Project

6. Reading List:

Apodaca, Anthony A. and Larry Gritz. *Advanced RenderMan: Creating CGI for Motion Pictures*. Morgan Kaufmann, 2000. ISBN 1-55860-618-1.

7. Bibliography:

Glassman, Arnold, Todd McCarthy and Stuart Samuels (directors). *Visions of Light: The Art of Cinematography*. American Film Institute / NHK Japan Broadcasting Corporation, 1992.

Glassner, Andrew S. "Surface Physics for Ray Tracing" from An Introduction to Ray Tracing. Academic Press, 1989.

Kahrs, John, Sharon Calahan, Dave Carson, and Stephen Poster, A.S.C., "Pixel Cinematography: A Lighting Approach for Computer Graphics," *ACM Siggraph Course Notes #30*, 1996.

Stephenson, Ian. *Essential RenderMan Fast*. Springer, 2003.

8. Library Resources:

Alton, John. *Painting with Light*. University of California Press, 1995. (Originally published by Macmillan, 1947.) ISBN 0-520-08949-9.

Ebert, Dave, Ken Musgrave, Darwyn Peachey, Ken Perlin, and Steve Worley. *Texturing and Modeling: A Procedural Approach*. AP Professional, 1994. ISBN 0-12-228760-6.

Keller, Max. Light Fantastic: The Art and Design of Stage Lighting. Prestel Verlag, 1999.

Malkiewicz, Kris. *Film Lighting*. Prentice Hall Press, 1986. ISBN 0671622714.

Upstill, Steve. *The RenderMan Companion: A Programmer's Guide to Realistic Computer Graphics*. Addison-Wesley, 1990. ISBN 0-201-50868-0.