COMPUTER GRAPHICS & MOTION TECHNOLOGY (GPH)

GPH 205 | HISTORICAL FOUNDATIONS OF VISUAL TECHNOLOGY | 4 quarter hours
(Undergraduate)
This course is a survey of the development, application and meaning of visual technologies in a wide range of world cultures from pre-history to the present. It traces the unique intersection of mathematics and physical culture that marks design science, as it has been realized in a variety of human societies. The course includes works of art that emphasize those mathematical and geometric elements that are antecedent to contemporary graphic technology.

GPH 211 | PERCEPTUAL PRINCIPLES FOR DIGITAL ENVIRONMENTS I | 4 quarter hours
(Undergraduate)
An introduction to the visual, non-verbal principles incorporated in the effective presentation of on-screen environments. This course emphasizes the use of two-dimensional elements and their organization.

GPH 212 | PERCEPTUAL PRINCIPLES FOR DIGITAL ENVIRONMENTS II | 4 quarter hours
(Undergraduate)
Further experience with the visual, non-verbal principles incorporated in effective presentation of on-screen environments. This course emphasizes the use of three-dimensional elements, spaces and their organization. PREREQUISITE(S): ART 105, GD 105, GPH 211 or HCI 402.

GPH 213 | PERCEPTUAL PRINCIPLES FOR DIGITAL ENVIRONMENTS III | 4 quarter hours
(Undergraduate)
An introduction to the visual and communication principles for the structure and organization of time-based digital environments. Introduction to standard 2D animation software applications. PREREQUISITE(S): GPH 211 or GD 105 or equivalent.

GPH 250 | DIGITAL MODELING I | 4 quarter hours
(Undergraduate)
Introduction to 3D object modeling with an emphasis on visual applications and prototype design. Students will work with basic spatial operations in surface modeling and CAD interfaces and will produce an original object from pattern with computer-aided manufacture. Prerequisite: GPH 212.

GPH 255 | HAND PROTOTYPING FOR GRAPHIC VISUALIZATION | 4 quarter hours
(Undergraduate)
Paper prototyping techniques for pre-screen image design including form rendering, rapid visualization, descriptive geometry, and iconographic diagramming. Students will work from initial sketch versions through client presentation. PREREQUISITE(S): ART 106 and (GPH 211 or GD 105)

GPH 259 | DESIGN GEOMETRY | 4 quarter hours
(Undergraduate)
An historical and practical introduction to the visual applications of geometry. This CAD-based survey covers constructive geometry, surface symmetry, projective geometry, polyhedrons and spheroids through the discussion of historical precedents and practicum exercises.

GPH 269 | GRAPHIC GEOMETRIES | 4 quarter hours
(Undergraduate)
An historical and practical introduction to the visual applications of geometry. This CAD-based survey covers constructive geometry, surface symmetry, projective geometry, polyhedrons and spheroids through the discussion of historical precedents and practicum exercises.
Graduate standing is a prerequisite for this class.

GPH 279 | SCIENCE AND DESIGN OF SUNDIALS | 4 quarter hours
(Undergraduate)
This course explores ancient and early modern understanding of the cosmos and how this was successfully modeled into the sundial. About half of the course lectures are historical, while others explain the astronomy, geography and geometry used to design the dial. During lab sessions students design and create their own sundials.

GPH 321 | COMPUTER GRAPHICS DEVELOPMENT I | 4 quarter hours
(Undergraduate)
This course presents the fundamental mathematical foundations of graphics including an introduction to the basic geometric constructions of points, vectors, transformations, matrices and homogeneous coordinates. The course will explore applications of these mathematical techniques to rendering 3D scenes and lighting and shading surfaces in 3D. Advanced topics will include several key techniques from computational geometry such as the computation of object intersections and applications to rendering 3D scenes and object collisions. The focus of this course is on building the software from scratch rather than using a graphics application programming interface (API) so that students will gain a deeper understanding of the techniques they will be using in later courses through an API such as OpenGL or Direct3D. PREREQUISITE(S): CSC 300 or CSC 383 or CSC 393.
CSC 300 or CSC 383 or CSC 393 is a prerequisite for this class.

GPH 325 | SURVEY OF COMPUTER GRAPHICS | 4 quarter hours
(Undergraduate)
(Formerly GPH 371) A survey of basic 3D techniques, including interaction of light and color. The relationship between visual effect and geometry. Visual effects of rendering, texturing and lighting algorithms. Procedurally based modeling and an introduction to procedural animation techniques. PREREQUISITE(S): CSC 212 or ISM 330.

GPH 329 | COMPUTER GRAPHICS DEVELOPMENT II | 4 quarter hours
(Undergraduate)
Basic graphics architecture. Coordinate systems. Three-dimensional representations and transformations. Simple visible-surface algorithms. Introduction to illumination. Gouraud and Phong shading. Antialiasing. Texture mapping and elements of animation. Students create a graphics package using a high-level graphics API such as OpenGL. PREREQUISITE(S): CSC 361 and (GAM 325 or GPH 321)
CSC 361 and (GAM 325 or GPH 321) are prerequisites for this class.

GPH 336 | SMOOTH SURFACE MODELING FOR GRAPHICS AND ANIMATION | 4 quarter hours
(Undergraduate)
Parametric curves and surfaces. Continuity of curves and surfaces. Hermite, Bezier, B, and Catmull-Rom splines. Integer, adaptive and interactive generation of curves and surfaces. Surface subdivision. Quadric surfaces. Surface use in animations. PREREQUISITE(S): GPH 329 or GAM 370.
GPH 329 or GAM 370 is a prerequisite for this class.

GPH 338 | SURVEY OF 3-D ANIMATION | 4 quarter hours
(Undergraduate)
(Formerly titled Computer Animation Survey). Use of a commercially-based animation package for the purpose of communicating a narrative or visual information. Animation of transformations, deformations, cameras, and lights. Forward / inverse kinematics for character rigging. Prerequisites: ANI 201 and either GPH 325 or GPH 250.

GPH 339 | ADVANCED RENDERING TECHNIQUES | 4 quarter hours
(Undergraduate)
An introduction to shading techniques for highly realistic computer generated imagery. Texturing basics. Design, acquisition and application of layered textures to produce realistic dirt and aged surfaces. Turntables. Basic illumination and reflectance models. Elements of procedural texturing for organic surface materials such as wood and marble. The course includes an introduction to an industry standard shading language that is a powerful prototyping tool for both offline and real-time rendering environments. Students work in teams to produce convincingly organic environments. PREREQUISITE(S): GPH 325 or GPH 321 or (ANI 339 and GPH 355)

GPH 340 | PROCEDURAL SHADING | 4 quarter hours
(Undergraduate)
Procedural pattern generation, creating patterns such as marble and wood with noise, moving beyond the Phong Illumination model. Gaussian distributions and the Ward anisotropic model, BRDFs. Non-photorealistic rendering techniques such as "toon" shading and painterly techniques. PREREQUISITE(S): GPH 339.

GPH 341 | ADVANCED LIGHTING TECHNIQUES | 4 quarter hours
(Undergraduate)
Simple local models such as Phong, extensions to Phong (HDRI), ray-traced lighting and shadows, soft shadow generation using shadow maps, radiosity for producing ambient lighting and photon mapping for calculating realistic refracted light. Theory, lighting features supported, efficiency, and practical considerations for choosing the model in production. PREREQUISITE(S): GPH 339.

GPH 345 | DIGITAL SURFACE MODELING | 4 quarter hours
(Undergraduate)
This course is an upper level exploration of digital modeling in NURBS environments. Students will learn to creatively apply analytic methods of form production and scenic presentation suitable for application to design and engineering, medical and forensic visualization, and testing. In general this course will prepare students for 3-D graphic applications outside of the entertainment industry while rounding out their modeling skills for that industry, too. PREREQUISITE(S): GPH 212 or GPH 259 or ANI 230.

GPH 346 | SMOOTH SURFACE MODELING FOR GRAPHICS AND ANIMATION | 4 quarter hours
(Undergraduate)
(Formerly CSC 346; Cross-listed with CSC 536) Parametric curves and surfaces. Continuity of curves and surfaces. Hermite, Bezier, B, and Catmull-Rom splines. Integer, adaptive and interactive generation of curves and surfaces. Surface subdivision. Quadric surfaces. Surface use in animations. PREREQUISITE(S): GPH 329 or GAM 370.
GPH 329 or GAM 370 is a prerequisite for this class.

GPH 348 | RIGGING FOR ANIMATION | 4 quarter hours
(Undergraduate)
Readying 3D characters and other models for animation. Skeleton chains, joint orientations, and degrees of freedom. IK solvers, including single chains, rotation and splines. Methods for computing weights for skinning body and face, including semi-automated approaches. Considerations for mechanical objects, animals and low-polygon models. PREREQUISITE(S): GPH 338 or ANI 201.

GPH 350 | DIGITAL MODELING II | 4 quarter hours
(Undergraduate)
Advanced experience in object modeling and prototype design. Students will work with more sophisticated form relationships, reverse engineering and textures, and will produce an original object from slicing with computer-aided manufacture. PREREQUISITE(S): GPH 250.

GPH 355 | 3D SCRIPTING FOR ANIMATORS | 4 quarter hours
(Undergraduate)
This is an introductory course in scripting for a 3D production environment. Students will learn and apply basic programming concepts in order to improve the productivity of animators and modelers. Using script, we will automate repetitive tasks, customize the interface, and create new tools. Students will gain a fundamental understanding of how a 3D animation package functions behind the interface. Prerequisites: ANI 230 or GPH 338.

GPH 358 | COMPUTER GRAPHICS AUTOMATION | 4 quarter hours
(Undergraduate)
Covers the use of scripting and other automation techniques to generate computer graphics and animation. Emphasis on the benefits and differences of scripting languages compared to conventional graphics programming. Using commercially available scripting environments, students will generate rich, interesting graphics and animations that would not be possible with the conventional user interface. PREREQUISITE(S): ISM 330 or CSC 212 or GPH 355 or CSC 242.

GPH 360 | MODELING SPACES | 4 quarter hours
(Undergraduate)
The digital design and modeling of environmental spaces with attention to human use parameters. PREREQUISITE(S): GPH 250.

GPH 372 | PRINCIPLES OF COMPUTER ANIMATION | 4 quarter hours
(Undergraduate)
(Formerly CSC 372) This course will cover a range of topics in introductory 3D Computer Animation. Topics covered will include key framing, interpolation, hierarchies, inverse kinematics, particle systems, and the basics of physically based simulation and modeling. PREREQUISITE(S): GPH329 or GAM 370.
GPH 329 or GAM 370 is a prerequisite for this class.

GPH 375 | ADVANCED GRAPHICS DEVELOPMENT | 4 quarter hours
(Undergraduate)
(Formerly CSC 375) Survey of standards and current modular technology for 2D and 3D graphics software development. Use of software development toolkits to create "plug-ins" and other modularly organized functionality enhancements for selected commercially available graphics packages. PREREQUISITE(S): GPH 329 or permission of instructor.

GPH 380 | VISUALIZATION | 4 quarter hours
(Undergraduate)
An in depth introduction to a wide range of visualization techniques focusing on medical and scientific applications. Introduction to programming using a visualization package, use of color for feature extraction and enhancement, false color mapping techniques, reconstruction techniques, iso surface generation, stream lines and ribbons, spatial set operations and projections of higher-dimensional data sets. Prerequisite(s): GPH 325.

GPH 387 | FORENSIC ANIMATION | 4 quarter hours
(Undergraduate)
Techniques and issues in forensic animation. Application of modeling and rendering to the recreation of time-based events for legal purposes. Survey of research and interview techniques. Demonstrative recreation and physically-based recreation. Issues of accuracy, verification, certification and ethics. Students research and recreate an event with forensic value. Possible project areas include motor vehicle incidents, aviation events, product liability, medicine, and trademark infringement. Prerequisites: GPH 338 or ANI 231.

GPH 388 | PRODUCTION PIPELINE TECHNIQUES | 4 quarter hours
(Undergraduate)
An essential aspect of CGI is the skill to effectively manage data for an entire show, and to know how to monitor renders and image processes with the end result of assembling the finished animation. Students taking this course will gain hands-on experience in render queue management, automated file/image processing and manipulation, disk resource management, data archiving, conversion of outside vendor media and scripting tools to automatic common tasks and improve workflow. Students will work in teams to complete large-scale asset management and rendering projects. Prerequisites: CSC 212 or CSC 262.

GPH 389 | REAL-TIME GRAPHICS TECHNIQUES | 4 quarter hours
(Undergraduate)
This course will cover the basic algorithms and techniques used in today's real-time graphics systems. Topics will include the following: an introduction to computational geometry including computation with polygonal meshes. Alternate scene representations for efficient geometry culling, including BSP trees and oct-trees. Bounding volume hierarchies, box-trees and R- trees, and application to geometry culling. Programmable graphics hardware and its applications to geometric deformations and surface rendering. PREREQUISITE(S): GPH 329 or GAM 370.
GPH 329 or GAM 370 is a prerequisite for this class.

GPH 390 | TOPICS IN GRAPHICS | 4 quarter hours
(Undergraduate)
Description: May be repeated for credit. PREREQUISITE(S): Permission of Instructor.

GPH 395 | COMPUTER GRAPHICS SENIOR PROJECT | 4 quarter hours
(Undergraduate)
A group project involving analysis, design, creation, implementation and testing of a large project such as an animation, an interactive multimedia presentation or a video game. Portfolio creation and critique. Discussion of strategies for graduate school and the job market. PREREQUISITE(S): GPH 338 or GPH 372.

GPH 399 | INDEPENDENT STUDY | 1-8 quarter hours
(Undergraduate)
Variable credit. PREREQUISITE(S): Consent of dean.

GPH 425 | SURVEY OF COMPUTER GRAPHICS | 4 quarter hours
(Graduate)
Expression of visual intent through geometry and procedure. A survey of basic 3D techniques, including interaction of light and color. Visual effects of rendering, texturing, and lighting algorithms. Procedural modeling techniques and an introduction to procedurally-based texturing and animation. PREREQUISITE(S): CSC 212.

GPH 436 | FUNDAMENTALS OF COMPUTER GRAPHICS | 4 quarter hours
(Graduate)
An accelerated introduction to the graphics development environments and to graphical programming. Provides an in depth discussion of the basic mathematical language of computer graphics: vectors, transformations, homogeneous coordinates and their associated data structures. Advanced topics will include sampling theory and interpolation. Also provides a basic introduction to industry standards in graphics development, including specifying transformations and viewing parameters. PREREQUISITE(S): CSC 393 and MAT 150.
CSC 393 and MAT 150 are prerequisites for this class.

GPH 438 | COMPUTER ANIMATION SURVEY | 4 quarter hours
(Graduate)
Survey of methods used in computer animation. This course uses commercially available software packages to teach techniques for animation and digital video production. The techniques covered include storyboarding, key frame animation, audio and video editing. PREREQUISITE(S): GPH 425 or GPH 469.
GPH 425 (or GPH 469) is a prerequisite for this class.

GPH 448 | COMPUTER GRAPHICS SCRIPTING | 4 quarter hours
(Graduate)
Covers the use of scripting to generate computer graphics and animation. Emphasis on the benefits and differences of scripting languages compared to conventional graphics programming. Using commercially available scripting environments, students will generate complex graphics and animations that would not be possible with the conventional user interface. PREREQUISITE(S): GPH 438.

GPH 450 | DIGITAL MODELING I | 4 quarter hours
(Graduate)
Introduction to 3D object modeling with an emphasis on visual applications and prototype design. Students will work with basic spatial operations in surface modeling and CAD interfaces and will produce an original object from pattern with computer-aided manufacture. PREREQUISITE(S): HCI 470.

GPH 469 | COMPUTER GRAPHICS DEVELOPMENT | 4 quarter hours
(Graduate)
Basic graphics architecture. Coordinate systems. Three-dimensional representations and transformations. Simple visible-surface algorithms. Introduction to illumination. Gouraud and Phong shading. Antialiasing. Texture mapping and elements of animation. Students create a graphics package using a high-level graphics API such as OpenGL. PREREQUISITE(S): CSC 461 and (GAM 425 or GPH 436)
CSC 461 and (GAM 425 or GPH 436) are prerequisites for this class.

GPH 487 | FORENSIC ANIMATION | 4 quarter hours
(Graduate)
Techniques and issues in forensic animation. Application of modeling and rendering to the recreation of time-based events for legal purposes. Survey of research and interview techniques. Demonstrative recreation and physically-based recreation. Issues of accuracy, verification, certification and ethics. Students research and recreate an event with forensic value. Possible project areas include motor vehicle incidents, aviation events, product liability, medicine, and trademark infringement.

GPH 536 | SMOOTH SURFACE MODELING FOR GRAPHICS AND ANIMATION | 4 quarter hours
(Graduate)
Parametric curves and surfaces. Continuity of curves and surfaces. Hermite, Bezier, B, and Catmull-Rom splines. Integer, adaptive and interactive generation of curves and surfaces. Surface subdivision. Quadric surfaces. Surface use in animations. PREREQUISITE(S): GPH 469 or GAM 470.
GPH 469 or GAM 470 is a prerequisite for this class.

GPH 538 | RIGGING FOR ANIMATION | 4 quarter hours
(Graduate)
Readying 3D characters and other models for animation. Skeleton chains, joint orientations, and degrees of freedom. IK solvers, including single chains, rotation and splines. Methods for computing weights for skinning body and face, including semi-automated approaches. Considerations for mechanical objects, animals and low-polygon models. PREREQUISITE(S): GPH 438.

GPH 539 | ADVANCED RENDERING TECHNIQUES | 4 quarter hours
(Graduate)
An in-depth examination of texturing techniques for highly realistic computer generated imagery. Design and implementation of layered textures to produce realistic dirt and aged surfaces. Cost analysis of advanced illumination and reflectance models, including environment and shadow mapping, and ambient occlusion. Procedural texturing including pattern generation and the application of noise to produce organic surfaces. Shader development using an industry standard. Prototyping for both offline and real-time rendering environments. Students work in teams to produce convincingly organic environments. PREREQUISITE(S): GPH 425 or GPH 436 or (ANI 439 and GPH 355)

GPH 540 | PROCEDURAL SHADING | 4 quarter hours
(Graduate)
Procedural pattern generation, creating patterns such as marble and wood with noise, Moving beyond the Phong Illumination model: Gaussian distributions and the Ward anisotropic model, BRDFs. Non-photorealistic rendering techniques such as "toon" shading and painterly techniques. PREREQUISITE(S): GPH 539.

GPH 541 | ADVANCED LIGHTING TECHNIQUES | 4 quarter hours
(Graduate)
Simple local models such as Phong, extensions to Phong (HDRI), ray-traced lighting and shadows, soft shadow generation using shadow maps, radiosity for producing ambient lighting and photon mapping for calculating realistic refracted light. Theory, lighting features supported, efficiency, and practical considerations for choosing the model in production. PREREQUISITE(S): GPH 539.

GPH 560 | MODELING SPACES | 4 quarter hours
(Graduate)
The digital design and modeling of environmental spaces with attention to human use parameters. PREREQUISITE(S): any GPH 400-level course or consent of instructor.

GPH 565 | DESIGNING FOR VISUALIZATION | 4 quarter hours
(Graduate)
Sources of graphical integrity and sophistication. Data-Ink maximization. Data density. The use of color to enhance features in data sets and the communication of information . Effective use of space and time. Use of 3D techniques to display multi-dimensional data. The use of isosurfaces and volumetric techniques to display features of data sets. Students will use a programmable system to produce their visualizations and will learn how to use procedural techniques to express graphical intent. (Only one of GPH 570 and GPH 565 may be taken for credit) Prerequisite(s): GPH 448 and HCI 470.

GPH 570 | VISUALIZATION | 4 quarter hours
(Graduate)
(Formerly CSC 570) Reconstruction techniques. Voxel classification and isosurface generation. Spatial set operations. Projections of higher-dimensional data sets. Data feature enhancement. False color mapping. Survey of applications in science, engineering and medicine. PREREQUISITE(S): GPH 469 or GAM 470.
GPH 469 or GAM 470 is a prerequisite for this class.

GPH 572 | PRINCIPLES OF COMPUTER ANIMATION | 4 quarter hours
(Graduate)
(Formerly CSC 572) This course will cover a range of topics in introductory 3D Computer Animation. Topics covered will include key framing, interpolation, hierarchies, inverse kinematics, particle systems, and the basics of physically based simulation and modeling. PREREQUISITE(S): GPH 469.

GPH 575 | ADVANCED GRAPHICS DEVELOPMENT | 4 quarter hours
(Graduate)
Survey of standards and current modular technology for 2D and 3D graphics software development. Use of software development toolkits to create "plug-ins" and other modularly organized functionality enhancements for selected commercially available graphics packages. PREREQUISITE(S): GPH 448 and (GPH 469 or GAM 470)
GPH 448 and (GPH 469 or GAM 470) are prerequisites for this class.

GPH 580 | HARDWARE SHADING TECHNIQUES | 4 quarter hours
(Graduate)
This class explores the current trends in programmable computer graphics hardware. Modern graphics processing units (GPU's) are becoming increasingly powerful and fully programmable parallel processing units. They make extremely sophisticated effects in computer graphics, such as shadows, displacement maps, skinning, motion blur, reflections and refractions, possible in real-time scenes. In addition these increasingly general programmable units are being used for far more general computing problems from traditional searching and sorting algorithms to computational problems in physics such as the diffusion equation and fluid flow. In this course we will explore the applications of hardware shading to computer graphics, including advanced lighting, shading and surface effects. As time allows, we will explore other applications such as physics and computer science. Prerequisites: GPH 469 or GAM 470.
GPH 469 or GAM 470 is a prerequisite for this class.

GPH 595 | TOPICS IN GRAPHICS | 4 quarter hours
(Graduate)
May be repeated for credit. PREREQUISITE(S): Permission of instructor.