Instructor: Adrian Mendoza, M. Arch II. Harvard University Graduate School of Design
Email: Adrian@synthesis3.com

The course is divided into three phases. The first phase is an introduction to 3D space theory and modeling. The second phase makes extensive use of the application Maya as a tool for 3D modeling and animation, and the last phase integrates work created in Maya with digital video.

Phase 1 [week 1-3]

Week 1: Introduction to 3D Space Theory

Lecture [ Sept. 17 ]
The first week of lecture is a foundation for both the theory and the practice of 3D design and animation that will be used extensively over the course of the semester. To develop a conceptual framework and a common vocabulary, students are introduced to 3D Space Theory: perspective, the framing of images, projections, scale, coordinate systems, and the geometric modeling of objects are among the topics covered. Students are also introduced to the methods of effective project management of 3D design and animations using storyboarding and production-noting. Students are immediately encouraged to generate ideas for their final projects through the storyboarding process.

Lab [ Sept. 20 ]
In this lab, students will be exposed to the user interfaces of FormZ and Maya for comparison and contrast. Emphasis will be placed on how these applications are structured for the design and modeling of 3D objects within virtual spaces.

Week 2-3: Polygon Modeling - FormZ

Lecture [ Sept. 24/ Sept. Oct 1]
To develop the concepts of view-space and form, students will be introduced to a basic 3D modeling environment using FormZ. We will explore how complex objects in 3D space can be derived from basic polygonal objects such as cubes, spheres, cylinders, cones, and torii. We will also examine the geometrical limitations of using polygons as the building blocks of 3D models.

Lab [ Sept. 27/ Oct 4]
As an exercise, students will build 3D models from basic polygonal shapes. Students will be encouraged to create variations on their models to examine the use of perspective and framing in modeling. The exercises are designed to develop a strong command of modeling objects in a 3D environment using techniques such as rotations, translations, scaling, unions, and differences.

Phase 2 [week 4-10]

Week 4: Intro to MAYA and Film Theory

Lecture [ Oct. 8 ]
The lecture will introduce the theory of NURBS space within the MAYA interface, serving as a contrast to polygonal space within FormZ. We will also introduce the basics of film theory. We will look at terms and
procedures for film work that are essential to the applying these concepts in MAYA.

**Lab [ Oct. 11 ]**
This will focus on the introduction of the MAYA interface and of the conversion of FormZ objects into the Maya environment. Students will model complex shapes to understand the potential of the application Maya over FormZ.

**Week 5 - 6: Intro to NURBS Modeling in MAYA**

**Lecture [ Oct. 22/ Oct 29]**
The lecture will introduce the use of complex shapes in 3D environments. Students will learn about objects, such as NURB surfaces and spline objects, as the basic building blocks for higher-level 3D modeling. The use of NURB surfaces and spline objects will serve as a contrast to polygonal shapes used in basic 3D modeling. Students will learn to discern the appropriate use of polygonal objects vs. NURB surfaces and spline objects.

**Lab [ Oct. 25/ Nov 1]**
We will focus on basic modeling of NURB surface and objects in MAYA. We will also examine the use of polygons within this new application. Students must work on a basic model to practice on techniques within the application.

**Week 7 : Rendering in MAYA 1**

**Lecture [ Oct. 29 ]**
Rendering techniques in the MAYA environment will be taught over the next two weeks. Color theory and the use of shade, shadow, and transparency in the 3D environment will be introduced. We will extensively examine at case study of lighting and color to understand how to generate photorealistic scenes rendered in MAYA. A special focus will be placed on the creation of background and foreground scenes that are packaged with Maya's environmental controls.

**Lab [ Nov. 01 ]**
Students will learn how to prepare and develop files and objects for rendering. Students are required to apply what they have learned about perspective and color theory to rendered stills that they will produce. Students will begin to author their own original work using these rendering techniques in lab.

**Week 8 : Rendering in MAYA 2**

**Lecture [ Nov. 05 ]**
Our focus this week will be on lighting techniques for objects and scenes. We will use the objects and lighting elements that are found in the MAYA application. We will study examples illustrating refraction, reflection, radiosity, absorption, and shadowing of light in the MAYA platform. We will study the use of light on textures to dramatize the color and tones of scenes.

**Lab [ Nov. 08 ]**
This week, students are expected to work on their projects and apply lighting techniques taught in class on their own models and scenes. The use of light, shade, and shadows should be used to highlight and contrast elements of their scenes and 3D models.

**Week 9 : Texture Mapping in MAYA**

**Lecture [ Nov. 12 ]**
Image textures and bump-transparency mapping in a modeling environment will be introduced. We will examine a case study to help introduce the concepts of photo-granularity and texture mapping to create realistic surfaces. Emphasis will be placed on understanding how photorealism and consistency can be maintained in the 3D modeling environment. Counterexamples that illustrate how and why certain 3D rendered effects fail to be realistic will be discussed at length.

**Lab [ Nov. 15 ]**
Students will create and produce textures for 3D models and scenes. Students are required to bring in images for their own translation and production into photo-realistic texture maps. If time permits, the class will visit a site to
film and will explore how to augment the scene with 3D generated objects and models that maintain a high degree of photorealism.

**Week 10 : Animation Theory 1**

**Lecture | Nov. 19 |**
This is the first of a two-week introduction to the concepts of key frame animation and cameras in a 3D environment. We will study examples that use simple and complex key frame animation in a model. The exploration will look at the development of an animation frame and will motivate the use of animation within a project. Concepts pertaining to animation, such as the frame rate, still composition, and motion path will be discussed. We analyze various case studies to examine the limitations of various animation techniques.

**Lab | Nov. 22 |**
This week's lab will be focus on the production of key frame animations within selected student projects. We will study how to effectively use the Maya interface for animation.

**Week 11 : Thanksgiving Holiday**

**Phase 3 [week 11-16]**

**Week 12 : Compositing 1: Still Images on Video/ Particle Dynamics 1**

**Lecture | Dec. 03 |**
Before expanding the previous week's lessons on animation theory, we learn how to create composites of 3D objects and scenes onto digital video and other media. Topics from previous weeks, such as the use of color, lighting, and scale, will be used to guide the creation of composites onto digital video stills.

**Lab | Dec. 06 |**
Students will use key frame animation and create stills for use in digital video. We'll use the application Final Cut Pro as a tool for this simple compositing. Students will also participate in an outside exercise on how to shoot digital video for use in composites [time, TBA].

**Week 13 : Animation Theory 2/ Particle Dynamics2**

**Lecture | Dec. 10 |**
This week continues the Introduction to object animation. We will use motion paths in MAYA to move objects. We will also develop variable rate object animations for the use on video or on a still background. Case studies will be used in class to develop the necessary concepts of the object animation process.

**Lab | Dec. 13 |**
Students should arrive at lab with their own object animations and scenes this week. Students must provide a storyboard and notes that detail how they created their object animations. Student work will be reviewed in lab on a one-on-one basis.

**Week 14 : Compositing 2: Animation on Video/ Rigid Body Dynamics**

**Lecture | Dec. 17 |**
We will develop the use of complex movements and object animations onto a video or complex background. We will also explore the use of masking in video and digital animation to produce desired special effects in a scene. The use of layering in managing objects and animations on digital video will be introduced.

**Lab | Dec. 20 |**
The focus this week will be complex compositing and the layering of scenes introduced in class. Students should use their own work to replicate the effects demonstrated in class. Once again, lab time will be used to review the progress of individual student projects. Students are required to submit their storyboards and notes as well.

**Week 15 : Animation Theory 3/ Soft Body Dynamics**

**Lecture | Jan. 07 |**
This week continues the animation. We will re-focus on the animation theory and look at complexities of creating rendered scene.

**Lab [ Jan. 10 ]**

Students will continue to work independently on their own projects and animations.

**Week 16 : Final Review**

**Lecture [ Jan. 14 ]**

Review of final project.**

**The Final project will consist of an animation on video or in an interactive multimedia environment such as Director with the use of MAYA as modeling tool to create content. Students are required to demonstrate proficiency in animation, render techniques, and texture mapping. Students will be allowed to incorporate compositing techniques of images and video on to their final project. Students are also recommended to use live video for the composition of objects. The final outcome of the projects is dependent on nature of the student project’s intended use and theme. Story board and production notes are required with the submission of the final project. All final material will be submitted on digital or video media such as a CD-ROM or VHS tape. This requirement is to ensure the submission of a polished, professional-quality project.**