SAGRADO
Universidad del Sagrado Corazón

School of Arts, Design, and Creative Industries

SYLLABUS

TITLE: Three-Dimensional Modeling

CODE: IND 105

PREREQUISITE: N/A

CREDITS: 3 credits | 45 contact hours |1 term

DESCRIPTION

Introduction to the materials manufacturing and specification process using digital 3D drawing. Content includes design visualization, creation, and application of computer-generated 3D models in the manufacturing, communication, and publishing industries. Students will model their 3D designs from the original, hand-drawn idea to the use of a surfaces and solids modeling program. They will make use of Boolean operations in the construction and editing of models, display commands, details, geometric translation, rendering, and presentation.

JUSTIFICATION

As a form of visual communication of their proposals, it is necessary for students to understand, use, and work with the tools of analog and digital modeling, layout, prototyping, and operation, as instruments for the designed products.

COMPETENCES

The course develops the following competences in students:

- **Communication**
- **Research and exploration**

OBJECTIVES

After completion of the course, students will be able to:

1. Build three-dimensional drawings through reverse engineering.
2. Build and deconstruct their design proposals so they can draw and specify them by component and as a whole.

3. Develop digital technical drawings in two and three dimensions, represent materials and operation of their products.
4. Substitute, test, or modify complex surfaces in NURBS.
5. Estimate materials and their costs.
6. Become familiar with digital manufacturing processes, both additive and subtractive.

CONTENTS

I. Introduction to 3D digital drawing:
   A. Basic Rhino 3D commands in 2D:
      1. Creating Objects:
         a) Line (or Polyline)
         b) Curve
         c) PointsOn (displays Control Points)
         d) EditPtOn (displays Knots)
         e) Rectangle (or Polygon)
         f) Circle (or Arc)
         g) TextObject: insert text as an object (note: to record vectors, select curves, not surfaces or solids)
         h) Hatch: fill a closed curve with a pattern (for raster engraving)
II. Measurement:
   A. Length: report (on the command line) the total length of a line or curve.
   B. Distance: report the distance between two points.
   C. Area: report the area within a closed curve.
   D. Dim: create a dimension (note: the text of the dimension does not change if the point where it was made has changed)
III. Transforming an existing object:
   A. Move: move an object from one point to another.
   B. Copy: copy and move an object (CTRL-C and CTRL-V copy and paste on top of the original)
   C. Scale: resize an object, by the scale factor or a before and after point size reference.
   D. Scale 1D: resize lines or stretch a planar object into a single dimension.
   E. Scale 2D: resize lines or stretch an object, maintaining its proportions.
   F. Align: align an object with a reference (helps centralizing texts)
   G. Mirror: copy and mirror an object around its axis.
   H. Extend: continue a line or curve.
   I. Rotate: rotate the object around an axis.
   J. Array: copying and moving an object in an xyz array.
   K. ArrayPolar: copy and move an object a certain number of times around a pivotal point.
   L. Offset: copy an object in the same place and then rescale it, maintaining its proportions.
   M. Orient: move, rotate, and scale an object with a single command.

IV. Combining or separating objects:
   A. Join/Explode: combine multiple contiguous segments into one curve/polyline, and vice versa (to be able to use the hatch or area command, etc. it must be closed).
   B. Group/Ungroup: group/ungroup multiple objects by selecting or moving.
   C. Divide: divide lines equally.
   D. Split: split a line/curve at a point or intersection.
   E. Trim: split intersecting curves and automatically delete the segment you want to cut.
V. Navigating within a viewport:
   A. Zoom (alias: z): grab a window in the viewport. The viewport will zoom in or out.
   B. Zoom Selected (alias: zs): Zooms viewport to the size of the selected objects.
   C. Zoom Extents (alias: ze): Zooms viewport will extend until all objects are visible.
   D. Pan: slides the viewport up/down/left/right.
   E. RotateView/RotateCamera: tumble around a view or tumble the view around.
   F. MaxViewport: maximize the current view.
   G. UndoView/RedoView: undo or redo the last view.
VI. Basic commands of Rhino 3D in 3D:
   A. Basic solids:
      1. Box -Sphere (Ellipsoid)
      2. Cone (TCone)
      3. Pyramid (TruncatedPyramid)
      4. Cylinder (Tube) (Torus)
      5. Pipe
   B. 2D curves to 3D shapes:
      1. ExtrudeCrv: make a surface sweeping a curve using a line guide.
      2. Revolve: make a surface by rotating a curve around an axis.
      3. Loft: make a surface that connects two or more curves.
      4. Sweep: make a surface by sweeping a curve through another curve.
VII. 3D shapes to 2D curves:
   A. dupEdge: produce a curve on the edge of a solid.
   B. dupBorders: produce a curve on the edge of a surface
   C. make2d: create 2D, according to the selected view
   D. unrollSrf: change a volume in flat components
   E. Import/export: import and export models
VIII. Modeling:
   A. Precision modeling
IX. Generating 2D and 3D technical drawings and exporting them
X. Materials:
   A. Editing materials and assigning
XI. Rendering:
   A. Render in Rhino 3D
      1. Render in color

2. Render in material
        3. Render in Keyshot
        4. Introduction to Keyshot
XII. Materials:
    A. Editing materials and assigning
    B. Render in material
    C. Color
    D. Base
    E. Reflexes
    F. Self-illumination
    G. Transparency
    H. Bumps
    I. Procedural bumps
    J. Brilliance
XIII. Library
    A. Development of blocks and materials
    B. Mapping – decal – texture unwrapping
XIV. Lighting
    A. Methods
        1. Study of the scene to be illuminated
        2. Lighting resources, properties and lighting parameters
        3. Sombras
        4. Studio, outdoor, indoor, and artificial lights
        5. Using Dynamic Ranges: HDRI
        6. Environment
        7. Stage and background effects
        8. Channels
        9. Rendering parameters
        10. White balance adjustment
        11. Post process
XV. Preparation for additive and subtractive manufacturing method:
    A. Additive manufacturing:
        1. Preparation of drawings for 3D printing
        2. Valid polysurface: closed solid polysurface
        3. ShowEdges (selection of Naked Edges)
        4. JoinEdge (arrangement of Naked Edges)
    B. Subtractive manufacturing:
        1. Preparation of drawings for CNC cutter
        2. Nesting
        3. V-Carving toolpath
        4. Drill bits
    C. Preparation of drawings for laser cutter
        1. Line value
        2. Heat intensity and power

METHODOLOGY

The following strategies from the active learning methodology are recommended:

- Project Oriented Learning -**POL**
- Research Based Learning - **RBL**
- Collaborative Learning – **CL**
- Visual and didactic resources on the Internet
- Talks, conferences, exhibitions

EVALUATION

Oral presentations	25%
Partial assignments	40%
Project	30%
Participation	<u>5%</u>
TOTAL	100%

LEARNING ASSESSMENT

The institutional assessment rubric is applied to the course's core activity.

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RECCOMMENDED RESOURCES

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SUBSCRIPTION DATABASES

https://biblioteca.sagrado.edu/listado-de-bases-de-datos-bmmtg

Academic Search Ultimate: This database covers almost all academic disciplines. It includes 1,396 searchable journals with cited references. Includes more than 75,000 Associated Press videos.

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Fuente Académica Plus: The most comprehensive database of academic journals in Spanish and Portuguese. Hundreds of quality titles from Latin America, Portugal, and Spain cover all major subject areas. More than 600 full-text journals in Spanish and Portuguese that are not free access.

Material Sciences Database: This database offers its users the tools and content to stay well-informed of the latest research in the field, conduct comprehensive literature reviews, or develop solid basic knowledge for new researchers.

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