ISDN 2300 – Introduction to 3D Design

School:	**School of Engineering**
Subject Area:	**Integrative Systems and Design**
Course Credit:	**3**
Instructor:	**LIU Yuan**
Pre-requisite/co-requisite:	**Nil**

Notes:

- The syllabi provided here is for reference only and may be subject to changes and adjustments as determined by the course instructors.

The Hong Kong University of Science and Technology

UG Course Syllabus

Introduction to 3D Design

ISDN2300

No. of Credits: 3

Any pre-/co-requisites: nil

Name: LIU Yuan

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Office Hours: Wednesday 12:00 pm – 6:00 pm

Course Description

This course will provide the theoretical principles and real-life examples of a wide variety of digital design technology. The course includes using computer-aided techniques to convert sketches into digital 3D models, animate static 3D models into computer animation, and finally render the 3D models to become the final product image or video. The course also describes how the 3D models and renderings are being used in Virtual Reality and Augmented Reality.

Topics covered will include Photogrammetry, Fundamentals of 3D Modeling, NURBS, Principles of Traditional Animation, Computer Animation, 3D Rendering, Virtual Reality and Augmented Reality. Instructor's approval is required for enrollment in the course.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Be proficient in the fundamental concepts of computer-aided design

2. Use a variety of techniques to generate digital designs with differing levels of details.

3. Present designs in a professional manner

4. Realize a sketch as a 3D mode

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

[List specific assessed tasks, exams, quizzes, their weightage, and due dates; perhaps, add a summary table as below, to precede the details for each assessment.]

Assessment Task	Contribution to Overall Course grade (%)	Due date
Quizzes	20%	
Labs and Assignments	30%	
Final Project	50%	20/08/2025

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Quizzes	ILO1.	Quizzes evaluates the understanding of 3D design concepts [ILO1].
Labs and Assignments	ILO2.	Labs and assignments focus on using modern 3D modeling software (e.g., Blender, Maya) for specific designs [ILO2].
Final Project	ILO1, ILO2, ILO3, ILO4.	The final projects include designs, presentations, and a final animation. Students are required utilize their design concepts [ILO1] to build 3D models with 3D design techniques [ILO2, ILO4] and present their designs in class and with the final animation [ILO3].

Grading Rubrics

1. Quizzes popup at the beginning of the class, which contains several questions about the 3D design concepts. This evaluates whether students correctly understand fundamental concepts of computer-aided design.
2. Students use specific design techniques to meet a design target. Evaluation is based on accurate technique implementation (right software, proper workflows), quality of output (meeting geometric, aesthetic, and design principle requirements), and problem-solving ability.
3. Final project.
    a. **3D Designs**: Evaluated on complexity (detail, multiple elements, technique integration), creativity (unique concepts, innovative use of colors/materials, visual storytelling), and technical proficiency (correct mesh, texturing, polygon count).
    b. **Presentations**: Require clear explanation of design techniques and concepts, a well - structured flow, and quality visual aids.
    c. **Final Animation**: Judged by visual quality (resolution, lighting, realism), animation smoothness, narrative coherence, and overall impact.

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a profound understanding of all fundamental concepts in computer-aided design, including photogrammetry,

		NURBS, and traditional animation principles. Proficiently uses a vast array of techniques to generate highly detailed digital designs, often exceeding the standard requirements. Presents designs in an extremely professional and polished manner, with a high level of creativity and attention to detail. Can flawlessly realize a sketch into a 3D model, and also shows a deep understanding of how 3D models and renderings are applied in Virtual Reality and Augmented Reality. Actively engages in class discussions, collaborates effectively with peers, and may even contribute innovative ideas to enhance the learning experience.
B	Good Performance	Shows a solid knowledge and understanding of the main fundamental concepts in computer-aided design. Competently uses a good variety of techniques to generate digital designs with appropriate levels of detail. Presents designs in a professional manner, following the established guidelines. Can successfully realize a sketch into a 3D model. Has a clear understanding of how 3D models and renderings function in Virtual Reality and Augmented Reality. Participates actively in class, works well with others in group projects, and shows a strong motivation to improve skills.
C	Satisfactory Performance	Has a basic but sufficient knowledge of the core subject matter, such as understanding the fundamental concepts of 3D modeling, computer animation, and 3D rendering. Demonstrates the potential to achieve key professional skills, like using basic techniques to generate digital designs. Can make basic judgments when creating 3D models from sketches and presenting designs. Benefits from the course and shows the potential to further develop in the 3D design discipline. Completes all course assignments and participates moderately in class discussions.
D	Marginal Pass	Possesses a minimum threshold knowledge of the core subject matter related to 3D design. Has some potential to achieve basic professional skills, although there may be some gaps in understanding. Can make very basic judgments in creating 3D models from sketches and presenting simple designs. Gains some benefit from the course but may struggle with more complex concepts. Completes the minimum requirements of the course but may need additional support to progress in the discipline.
F	Fail	Demonstrates insufficient understanding of the fundamental concepts of computer-aided design, 3D modeling, animation, and rendering. Lacks the necessary skills to generate digital designs, present them professionally, or realize a sketch into a 3D model. Shows limited ability to think critically about how 3D models are used in Virtual Reality and Augmented Reality. Exhibits minimal effort in course assignments and class participation, not meeting the basic requirements for learning and development in the 3D design discipline.

Course AI Policy

Students are allowed to improve their works using AI and inspire their creativity by generating contents with AI. The outputs of AI should be refined by the students instead of directly being copied as submissions.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include strengths, areas for improvement. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy

Assignments may be submitted late by no more than 48 hours, weekend and holiday counted. The penalty for late submission is 50% of the score. No score will be given for submission after 48 hours.

Required Texts and Materials

1 3D Modeling

Margaret Becker, Pascal Golay, Rhino NURBS 3D Modeling, 2006

2 Animation

Principles of Traditional Animation Applied to 3D Computer Graphics, SIGGRAPH'87, pp. 35-44

Frank Thomas and Ollie Johnston, Disney Animation: The Illusion of Life, 1981

3 Rendering

Greg Humphreys and Matt Pharr, Physically Based Rendering: From Theory to Implementation, 2004. (Chapter 1, 6, 8, 10, 12)

4 Mixed Reality

Dieter Schmalstieg, Tobias Hollerer, Augmented Reality: Principles and Practice, 2016.

Steve Aukstakalnis, Practical Augmented Reality, 2016.

Steven M. LaValle, Virtual Reality, 2020. (FREE version available online)

Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, 2015.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Additional Resources

Additional materials for advanced level

Overall

MOOC course

Ravindra Goonetilleke and Sai-Kit Yeung, Digital Design

https://www.edx.org/course/digital-design

SIGGRAPH 2020 course

Mike Bailey, A Whirlwind Introduction to Computer Graphics

https://education.siggraph.org/cgsource/content/whirlwind-intro-cg

3D Modeling

SIGGRAPH Asia 2017 Course

Lap-Fai (Craig) Yu, Sai-Kit Yeung, Daniel Aliaga, and Hao (Richard) Zhang,

Modeling and Remodeling 3D Worlds

https://3dworldsblog.wordpress.com/

CVPR 2010 Tutorial

Carlos Hernandez, George Vogiatzis, and Yasutaka Furukawa

3D Shape Reconstruction from Photographs: a Multi-View Stereo Approach

https://carlos-hernandez.org/cvpr2010/index.html

Animation

SIGGRAPH 2019 Course

Adam W. Bargteil, University of Maryland, Baltimore County, and Tamar Shinar

An introduction to physics-based animation

https://education.siggraph.org/cgsource/content/introduction-physics-based-animation

Rendering

SIGGRAPH Course

Advances in Real-Time Rendering in 3D Graphics and Games

https://advances.realtimerendering.com/

Mixed Reality

SIGGRAPH 2017 Course

Gordon Wetzstein, Robert K Konrad, Nitish Padmanaban, and Hayato Ikoma

Build your own VR system: an introduction to VR displays and cameras for hobbyists and educators

https://education.siggraph.org/cgsource/content/build-your-own-vr-system