

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ ЕКОНОМІЧНИЙ УНІВЕРСИТЕТ
ІМЕНІ СЕМЕНА КУЗНЕЦЯ

ЗАТВЕРДЖЕНО

на засіданні кафедри
комп'ютерних систем і технологій
Протокол № 1 від 22. 08.2023 р.

ПОГОДЖЕНО

Проректор з навчально-методичної роботи



Каріна НЕМАШКАЛО

3D-ГРАФІКА

робоча програма навчальної дисципліни

Галузь знань	18 "Виробництво та технології"
Спеціальність	186 "Видавництво та поліграфія"
Освітній рівень	другий (магістерський)
Освітня програма	"Технології електронних мультимедійних видань"

Статус дисципліни	обов'язкова
Мова викладання, навчання та оцінювання	англійська

Розробник:
к.е.н., доцент

Ігор КОБЗЕВ

Завідувач кафедри комп'ютерних
систем і технологій

Олександр ПУШКАР

Гарант програми

Андрій ГОРДЕЄВ

Харків
2023

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS

APPROVED

at the meeting of the department
computer systems and technologies
Protocol No. 1 dated 22.08.2023



AGREED

Vice-rector for educational and methodical
work

Karina NEMASHKALO

3D-GRAPHICS

work program of the academic discipline

Branch of knowledge **18 «Production and technologies»**
Speciality **186 «Publishing and Printing»**
Educational level **second (master's)**
Educational program **"Technologies of electronic multimedia publications"**

Type of discipline **mandatory**
Language of teaching, learning and assessment **english**

Developer
ass. prof.

Igor KOBZEV

Head of the Department of
Computer Systems and
Technologies

Alexander PUSHKAR

Program Guarantor

Andrey HORDYEYEV

Kharkiv
2023

SUMMARY OF THE DISCIPLINE

The purpose of the work program is to maximize the implementation of personal qualities and integrated competencies of the master's degree in the discipline of 3D graphics, developed on the basis of educational standards using a competency-based approach to learning outcomes.

The main goal is achieved by systematizing, deepening and generalizing the knowledge that forms the theoretical and practical basis of the 3D graphics discipline for the Publishing and Printing program.

3D graphics has a wide range of applications in all types of design activities (interior design, creation of virtual museum spaces, animation) and in the visualization of various technological processes (animation of the movement of mechanisms, the internal structure of various structures, etc.)

The 3D graphics discipline plays a major role in the Master's degree program in Publishing and Printing.

The aims and objectives of the discipline 3D-graphics are determined by the scientific and professional aspects of training qualified specialists and consist in shaping the minds of masters on the basis of mastering the laws of information processes in an inseparable connection with the methods and ways of visualizing and modelling three-dimensional objects.

The objectives of the 3D graphics discipline are as follows:

- gaining a systematic understanding of the peculiarities of three-dimensional modelling;
- acquiring knowledge in the field of description, presentation and formalization of various capabilities of a 3D graphic editor;
- gaining skills in using three-dimensional modelling in solving various applied problems;
- acquaintance with the methods of creating virtual spaces.

The discipline 3D-graphics belongs to the cycle of professionally oriented disciplines in the speciality Publishing and Printing, specialization Technology of Electronic Multimedia Publications.

To study the discipline 3D graphics, you need to know the basics of the following disciplines: Higher Mathematics, Applied Mathematics, Engineering and Computer Graphics, Colour Theory, Computer Design Technologies, Computer Animation.

In studying the discipline of 3D graphics, the main didactic condition for the development of graduate competence is observed, which is the optimal synthesis of

contextual learning, modelling elements of the future work of a master's degree, and interdisciplinary integration.

The learning results and competencies formed by the discipline are defined in Table 1.

Table 1

Learning results and competencies formed by the discipline

Learning results	Competences that must be mastered by a student of higher education
LR 1	GC 2, GC 3, SC 5
LR 2	GC 1, GC 3, SC 5
LR 3	GC 2, SC 5
LR 4	GC 1, GC 3, SC 6
LR 5	SC 4
LR 6	SC 5
LR 7	GC 1, SC 5
LR 8	SC 5
LR 9	GC 2, GC 3
LR 10	GC 2
LR 11	GC 2, SC 11
LR 12	GC 2, GC 1
LR 13	GC 2, GC 3
LR 14	SC 9

where,

GC 1 Ability to apply knowledge in practical situations;

GC 2. Ability to generate new ideas (creativity);

GC 3. Ability to communicate in a foreign language;

SC 4. The ability to organize the operation of technical and software means for publishing information and materials processing, to analyze and evaluate the possibilities of adapting technological complexes for effective use during the preparation of all types of publishing and printing products in a specific production system

SC 5. The ability to develop and implement new technological processes, in particular resource- and energy-saving technologies, and types of products in the field of publishing and printing, to optimize production processes in accordance with the requirements;

SC 6. Manage complex activities in the field of publishing and printing, organize and improve the activities of publishing and printing industries, develop plans and measures for their implementation, ensure quality, and calculate the technical and economic efficiency of production;

SC 9. Conduct an analysis of modern digital media products as cultural forms of ways to increase the efficiency of the enterprise;

SC 11. Analyze the structure and content of interactive media projects

LR 1. To be responsible for the development of professional knowledge and practices, evaluation of the team's strategic development, formation of an effective personnel policy;

LR 2. Assess prospects, create scientifically and technically based forecasts, research and carry out conceptual and substantive modeling of industry development trends;

LR 3. Make effective decisions on issues of publishing and printing, including in difficult and unpredictable conditions; predict their development and market conditions; determine the factors affecting the achievement of set goals, in particular, consumer requirements; analyze and compare alternatives; assess risks and likely consequences of decisions;

LR 4. Communicate freely orally and in writing in Ukrainian and one of the foreign languages (English, German, Italian, French, Spanish) when discussing professional issues, research and innovations in the field of publishing and printing and related problems;

LR 5. To develop and execute projects of publishing and printing industries and systems of their engineering and technical support, taking into account engineering, legal, economic, ecological and social aspects, to carry out their informational and methodical support;

LR 6. Manage complex activities in the field of publishing and printing, organize and improve the activities of publishing and printing industries, develop plans and measures for their implementation, ensure quality, and calculate the technical and economic efficiency of production;

LR 7. Carry out computer design of individual components of the technological process;

LR 8. Develop and implement effective technologies, develop instructions and technological regulations for the production of publishing and printing products;

LR 9. Conduct research and/or conduct innovative activities in order to obtain new knowledge and create new technologies and products in the field of publishing and printing and in wider multidisciplinary contexts;

LR 10. Build and research models of technological processes of publishing and printing, evaluate their adequacy, determine limits of applicability;

LR 11. Apply modern experimental and mathematical methods, information technologies and specialized software for research and development in the field of publishing and printing;

LR 12. Search for necessary data in scientific literature, databases and other sources, analyze and evaluate these data;

LR 13. To use knowledge of domestic and international legislation regarding the protection and preservation of copyrights in the production of printed and electronic publications, packaging, multimedia information products and other types of publishing and printing products in practical activities.

LR 14. Analyze, discuss and determine the most appropriate decision regarding the design and applied implementation of the process of development of printed and multimedia products;

PROGRAM OF THE DISCIPLINE

Content module 1 Analytical 3D objects

Topic 1: Analytical 3D graphics

Analytical graphics. Classification of ways to build 3D graphs. Mathematical model of the surface. Description of analytical surfaces. The plane. Surfaces of the second order. Sphere. Two-cavity hyperboloid. Elliptical paraboloid. Hyperbolic paraboloid. Cylinder. Cone. Toroidal surface. The quadratic form. Matrix recording of the equation of the surface of the second order. Characteristic quadratic form.

3D graphics in *mathcad*. Algorithm for building a surface in *mathcad*. Matrix of nodal points. Algorithm for constructing surfaces of rotation. Tools for building 3D-graphs in *mathcad*. Properties of 3D graphs. Formatting of 3D graphs.

Topic 2. Fractal 3D graphics

The concept of a fractal. History of fractals. Classification of fractals. Geometric fractals. Algebraic fractals. Stochastic fractals. Spatial fractals. Areas of application of fractals. Mathematical description of fractals. Programs for creating and editing fractals. Editor of 3D fractals *Mandelbulb3D*. Generator of three-dimensional fractals *Incendia*. The *Incendia* interface. Initial creation and editing of fractals in *Incendia*. Exporting 3D fractals from *Incendia* to *3ds max*. Fractals in *3ds max*.

Content module 2 Polygonal 3D objects

Topic 3. Polygonal 3D graphics

The task of representing 3D objects. The main types of 3D models. Ways to represent models of geometric objects. The structure of the geometric model of objects. Point and wireframe representation of a geometric model of objects. General view of a parametric surface. Surface problem of three-dimensional objects. Polygonal model. Patch model. Three-dimensional task of three-dimensional objects. The concept of "voxel". Parametric problem of geometric objects. Types of parametric functions of two variables.

Types of editable surfaces: *Editable Mesh*, *Editable Poly*, *Editable Patch*, *NURBS Surface*. Convert *3ds max* objects into different types of surfaces. Setting up editing modes. *Vertex*, *Edge*, *Face*, *Polygon*, *Polygon*, and *Element* surface editing modes. Mesh modeling in *3ds max*. Modeling with polygons.

Topic 4. Spline 3D graphics

The concept of spline. Spline interpolation. Types of splines. The cubic spline. B-spline. *NURBS*. The function of the spline. Conditions for the formation of the

spline function. Spline in the form of Hermite. Spline in the form of Bezier. Polynomial spline interpolation. Design of curved surfaces. Primitives of splines. Additional spline objects. Create complex geometric three-dimensional objects based on spline shapes. Modifiers *Surface*, *Lathe*, *Sweep*, *Curve*, *Extrude*, and *Bevel*, *Loft*, and *Bevel*. Create three-dimensional objects based on splines. Use *NURBS* to create three-dimensional objects. Two types of *NURBS* curves and surfaces: *Point* and *CV*. Floating *NURBS* panel. Basic techniques for working with *NURBS* curves and surfaces. Sub-Object mode.

The list of practical (seminar) and/or laboratory work/tasks by academic discipline is given in the table. 2

Table 2

List of practical (seminar) and/or laboratory classes/tasks

Name of the topic and / or task	Content
Topic 1. Task 1.	Learning the mathcad interface
Topic 1. Task 2.	Creating 3D objects in the mathcad environment
Topic 2. Task 3.	Exploring the interface of the Incendia 3D fractal generator
Topic 2. Task 4.	Creating 3D fractals in the Incendia environment
Topic 3. Task 5.	Creating 3D scene objects in 3ds max based on Editable Mesh and Editable Poly
Topic 3. Task 5.	Creating 3D scene objects in 3ds max based on Editable Patch and NURBS Surface
Topic 4. Task 6.	Study of lecture material, preparation for laboratory classes.
Topic 4. Task 7.	Creating complex geometric 3D scene objects in 3ds max based on spline shapes
Topic 4. Task 8.	Creating 3D scene objects in 3ds max based on NURBS Surface

The list of independent work by academic discipline is given in the table. 3

Table 3

List of independent work

Name of the topic and / or task	Content
Topic 1 - 4	Study of lecture material
Topic 1 - 4	Preparation for laboratory classes

The number of hours of lectures, practical (seminar) and/or laboratory classes and hours of independent work are given in the work plan (technological map) for the academic discipline.

TEACHING AND LEARNING METHODS

The teaching methods used are aimed at activating and stimulating the learning and cognitive activity of higher education students. They are realized through the explanatory and illustrative method in lectures and the reproductive method in laboratory classes. Namely: presentations, illustrations (lectures 1-4), work in small groups (laboratory work 1-4)

ASSESSMENT FORMS AND METHODS

The university uses a 100-point accumulative system for evaluating the learning outcomes of students of higher education.

Current control is carried out during lecture, practical, laboratory and seminar classes and has the purpose of checking the level of preparedness of the student of higher education for the performance of specific work and is evaluated by the sum of points scored:

for disciplines with a form of semester credit control: the maximum amount is 100 points; the minimum amount is 60 points.

The final control includes the semester control and certification of the student of higher education.

Semester control is conducted in the form. differentiated credit or credit. The maximum rating for the study of the discipline during the semesters is estimated by the sum of points and is 100 points.

To evaluate the work of students in the first semester, the final grade is calculated as the sum of the marks for the performance and defense of laboratory work:

Current control: defense of laboratory works (80 points), individual educational and research tasks (20 points).

More detailed information about the evaluation system is given in the work plan (technological map) for the academic discipline.

RECOMMENDED LITERATURE

Main

1. Євсєєв, О. С. Створення інтерактивних медіа [Електронний ресурс] : навч. посіб. / О. С. Євсєєв ; Харківський національний економічний університет ім. С.

- Кузнеця. - Харків : ХНЕУ ім. С. Кузнеця, 2020. - 138 с. - <http://repository.hneu.edu.ua/handle/123456789/24522>
2. Пушкар О. І. Культура цифрових медіа [Електронний ресурс] : навчальний посібник / О. І. Пушкар, Є. М. Грабовський; Харківський національний економічний університет ім. С. Кузнеця. — Харків : ХНЕУ ім. С. Кузнеця, 2022. — <http://repository.hneu.edu.ua/handle/123456789/28184>
3. Akenine-Möller T., Haines E., Hoffman N., Pesce A., Iwanicki M., Hillaire S. - Real-Time Rendering, 4th Edition CRC Press. 2021 - 1196 p.
4. Lee Wylde - V-Ray My Way: A Practical Designer's Guide to Creating Realistic Imagery Using V-Ray & 3ds Max. 2021 Focal Press. - 220 p.
5. Лотошинська Н., Ізонін І. Технології 3D-моделювання в програмному середовищі 3ds Max з дисципліни "3D-Графіка" – Львів, Львівська політехніка., 2020. – 216 с.

Additional

6. Hrabovskyi Y. Method of construction of adaptive interface of multimedia product / Y. Hrabovskyi, T. Borzykh // Наукові записки [Української академії друкарства]. – 2021. – № 2 (63). – С. 52-63. URL: <http://repository.hneu.edu.ua/handle/123456789/27633>
7. Pushkar O. Development of information model of color reproduction process in polygraphic systems / O.Pushkar, A. Gordyeyev // Development Management. – 2021. - 19(1). - 35-41. URL: <http://repository.hneu.edu.ua/handle/123456789/28444>
8. Blende[1] r 3D By Example A project-based guide to learning the latest Blender 3D, Eevee rendering engine, and Grease Pencil, 2nd Edition Oscar Baechler, Xury Greer 2020
9. 3D computer graphics. ScienceDaily. Retrieved 2019-01-19.

Information resources on the Internet

10. 3D tutorials – URL : <https://3dtotal.com/tutorials/3d>
11. 3ds Max 2022 Tutorial: Beginner Crash Course (START HERE). URL : <https://area.autodesk.com/m/redefinefx/tutorials/3ds-max-2022-tutorial-beginner-crash-course-start-here>
12. 3DS Max Learn Basics Foundation Course – URL : <https://www.udemy.com/course/3ds-max-learn-basics-foundation-course/learn/lecture/5954680?start=30#learning-tools>

13. 3ds Max Modeling Tutorials for the Beginner – URL : <https://www.tutorialboneyard.com/3ds-max-modeling-beginner-tutorials/>
14. Autodesk-3ds-max– URL : <https://3dground.net/ua/articles/autodesk-3ds-max>
15. Сайт ПНС 3D graphics (186 Publishing and Printing) Igor KOBZEV.
[Електронний ресурс] – Режим доступу - <https://pns.hneu.edu.ua/course/view.php?id=7248>