Syllabus of the educational component

Program of educational discipline

Modern technologies in applied mechanics

Specialty
131 – Applied mechanics

Institute
NNI of Mechanical Engineering and Transport

Educational program
Applied mechanics.

Department
Foundry production (142)

Level of education
Master's degree

Course type
Special (professional), mandatory

Semester
1

Language of instruction
Ukrainian, English

Lecturers and course developers

Oleg Viktorovych Akimov

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Doctor of technical sciences, professor, head of the department of foundry production of NTU "KhPI"

Work experience - 37 years. Author and co-author of more than 200 scientific and methodical publications. Courses: "Certification and metrological quality assurance", "Modern technologies in applied mechanics" and others.
Learn more about the teacher on the department's website

General information

Summary

The course "Modern technologies in applied mechanics" develops knowledge about improving quality, reducing the cost of industrial products, reducing the time it takes to bring new products to the market, which remain the determining factors of success in industrial production today and in the foreseeable future. The most effective technologies that give a significant profit in a short period of time include automated design, engineering analysis and technological preparation systems (CAD/CAM/CAE systems), as well as enterprise design and engineering data management systems (PDM systems).

Course objectives and goals

To develop the student's ability to substantiate, develop and implement innovative production processes of obtaining and/or processing metals and alloys using the capabilities of computer technologies; introduction of modern computer technologies for research and testing of foundry production.

Format of classes

Lectures, laboratory classes, independent work, consultations. Abstract. Final control - exam.

Competencies

GC2. Ability to make informed decisions.
GC7. Ability to communicate in a foreign language.
GC8. Ability to learn and master modern knowledge.
FC1. The ability to apply specialized conceptual knowledge of the latest methods and techniques of designing and researching structures, machines and/or processes in the field of mechanical engineering.
FC5. The ability to set a problem and determine ways to solve a problem by means of applied mechanics and related subject areas, knowledge of methods of finding the optimal solution under conditions of incomplete information and conflicting requirements.
FC6. The ability to apply appropriate mathematical, scientific and technical methods, information technologies and applied computer software to solve engineering and scientific problems in applied mechanics.
FC7. Ability to describe, classify and model a wide range of technical objects and processes, based on deep knowledge and understanding of mechanical theories and practices, as well as basic knowledge of related sciences.
FC8. The ability to generate new ideas and the ability to substantiate new innovative projects and promote them on the market.

Learning outcomes

LR1. Apply specialized conceptual knowledge of the latest methods and techniques of design, analysis and research of structures, machines and/or processes in the field of mechanical engineering and related fields of knowledge.
LR 3. Apply automation systems for research, design and construction work, technological preparation and engineering analysis in mechanical engineering.
LR 4. Use modern methods of optimizing the parameters of technical systems by means of system analysis, mathematical and computer modeling, in particular under the conditions of incomplete and contradictory information.
LR 5. Independently set and solve problems of an innovative nature, argue and defend the obtained results and decisions.
LR 7. It is clear and unambiguous to present the results of research and projects, to convey one's own conclusions, arguments and explanations in national and foreign languages orally and in writing to colleagues, students and representatives of other professional groups of various levels.
LR 10. Search for necessary information in scientific and technical literature, electronic databases and other sources, assimilate, evaluate and analyze this information.
LR 12. Demonstrate the ability to perform modeling, static and dynamic analyzes of structures, mechanisms, materials and processes at the design stage using modern computer systems.
LR 15. Demonstrate knowledge of the structure, functioning, technical and software support of information and measurement computerized systems in machine-building production.

Student workload

The total volume of the discipline is 120 hours. (4 ECTS credits): lectures – 3 hours, laboratory classes – 16 hours, independent work – 72 hours.

Course prerequisites

To successfully complete the course, you must have knowledge and practical skills from the following disciplines: "CAD/CAM/SAE systems in foundry production", "Technology and equipment of special types of casting", "Heat exchange in a foundry mold", "Theory of the formation of castings".

Features of the course, teaching and learning methods, and technologies

Lectures are conducted interactively using multimedia technologies. On practical ones classes use a project approach to learning, game methods, focus on

application of information technologies in the implementation of modern CAD/CAM/CAE/PDM and CIM systems of foundry production. Study materials are available to students through OneNote Class Notebook..

Program of the course

Topics of lectures

Topic 1. The role of CAD/CAE systems in solving the need for casting quality management.
Trends and experience in casting quality management.
Topic 2. CAD systems existing in foundry production.
Classification and basic functionality of CAD systems
Topic 3. Light level CAD systems
COMPASS, Basis, AUTOCAD and Mechanical Desktop, CADdy++, VERSACAD, CadKey, Personal Designer, VISUALCADD. Functional capabilities of "CAD systems" of an easy level. The main disadvantages of "light" level CAD systems.
Topic 4. "Mid-level" CAD systems
SolidWorks (SolidWorks Inc.), SolidEdge (Intergraph), Cimatron (Bee-pitron). Pro/LUNIOR, PT/Modeler Engineer (Parametric Technology, PRE-LUDE DESIGN (Matra Division), Anvil Express, I-DEAS Artisan Series..
Topic 5. "high" level CAD systems
Unigraphics (EDS), Pro/Engineer (Parametric Technology) + CADDS 5 (Computervision), Catia (IBM/Dassault), Euclid (Matra Division), I/EMS (Intergraph), PE/SolidDesigner (Hewlett-Packard), Anvil 5000 , I-DEAS Master Series, ADAMS, ALIAS, DUST-5.
Topic 6. The structure of relationships between computer systems at different stages of the life cycle of castings.
Principles of computer control of the quality of castings
Topic 7. Principles of construction and use of CAD/CAM/SAE systems in foundry production
CAD/CAM/SAE for automation of design, analysis and technological preparation of castings, analysis of casting processes and characteristics of castings.
Topic 8. PDM systems in foundry production
Principles and structure of the construction of an automated system of analysis and quality control of castings.

Topics of the workshops

Practical classes within the discipline are not provided.

Topics of the laboratory classes

Topic 1. Classification and main functions of the AUTOCAD system
Topic 2. Using the capabilities of "CAD systems" at an easy level
Topic 3 Introduction to the possibilities of CAD systems of the "medium" level.
Topic 4 Getting to know the possibilities of CAD systems of a "high" level.
Topic 5 Study of the basics of modeling technological processes of Lithuania on SAE systems.
Topic 6. Practical use of the SAM/SIM system in foundry production

Self-study

The course involves writing an essay on the implementation of modern CAD/CAM/CAE/PDM and CIM systems. The result is drawn up in a written report.
Students are also recommended additional materials for independent study and analysis.

Course materials and recommended reading

Basic literature

1. Engelke WD How to Integrate CAD/CAM Systems: Management and Technology (Mechanical Engineering) / WD Engelke. - CRC Press, 1987. - 400 p.
2. Rudenko P. O. Designing technological processes in mechanical engineering: teaching. help K.: Higher school, 2013
3. Zbozhna O. M.; Basics of technology: a study guide Kyiv: Kondor, 2011. - 498 p4.

4. Burov, E. Computer networks Lviv: BaK, 2008. - 566 p.
5. Kozlovskyi, A. V. Computer technology and information technologies. - K.: Znannia, 2011. – 463 p.

Additional literature

1. Pequet Ch., Gremaud M. and RappazM.. Modeling of Microporosity, Macroporosity, and Pipe-Shrinkage Formation during the Solidification of Alloys Using a Mushy-Zone Refinement Method. Applications to Aluminum Alloys. //Metallurgical and Materials Transactions A, v.33A, July 2002 pp. 2095-2106.
2. Carlson KD, Lin Z., Hardin R., and BeckermannC.. Modeling of Porosity Formation and Feeding Flow in Steel casting. // Proceedings of the 56th SFSA Technical and Operating Conference, Paper No. 4.4, Steel Founders' Society of America, Chicago, IL, 2002..

Assessment and grading

Criteria for assessment of student performance, and the final score structure

100% of the final grade consists of assessment results in the form of credit (40%) and current assessment (60%).

Test: written task (2 questions from theories) and an oral report.
Current assessment: 2 modular control and calculation task (20% each).

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": show discipline, education, benevolence, honesty, responsibility. Conflict situations should be openly discussed in study groups with the teacher, and if it is impossible to resolve the conflict, it should be brought to the attention of the employees of the institute's directorate.
Regulatory and legal support for the implementation of the principles of academic integrity of NTU "KhPI" is posted on the website:http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by

22.08.2023
Date , signature

Head of the department
Oleg AKIMOV

22.08.2023
Date , signature

Guarantor of the educational program
Oleksandr SHELKOVY