# Fuzzy logic in intellectual systems
### Educational program component – mandatory (4.0 credits)

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| **Educational and Professional Program** | Information technology and project management |
| **Specialty** | 122 – Computer Science |
| **Field of knowledge** | 12 – Information technology |
| **Level of higher education** | first (bachelor's) |
| **Language of teaching** | Ukrainian |
| **Teacher profile** | Pasichnyk Halyna Saveliivna Head of the Department of Mathematical Modeling, Candidate of Physical and Mathematical Sciences, Associate Professor https://mathmod.chnu.edu.ua/pro-nas/spivrobitnyky/pasichnyk-halyna-saveliivna/ |
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| **E-mail:** | h.pasichnyk@chnu.edu.ua |
| **Course page in Moodle** | https://moodle.chnu.edu.ua/course/view.php?id=6786 |
| **Consultations** | Wednesday, 14:20 – 16:00 |

## ANNOTATION OF THE ACADEMIC DISCIPLINE

The purpose of studying the discipline is
- to form mathematical knowledge in the field of fuzzy set theory and fuzzy logic;
- to form skills in performing mathematical operations on fuzzy sets and fuzzy relations;
- to use fuzzy statements and linguistic variables to model complex systems.

The task of studying the academic discipline is
- to study the apparatus of the theory of fuzzy sets and fuzzy logic;
- to acquire practical skills in modeling fuzzy quantities, fuzzy statements, linguistic variables by students;
- to form skills in working with fuzzy sets, fuzzy relations, linguistic variables;
- to obtain basic knowledge in fuzzy modeling of various systems.

This course studies the theory of fuzzy sets, mathematical operations on fuzzy sets and fuzzy relations, and the use of fuzzy logic for modeling complex systems. Models and algorithms for fuzzy logical inference are studied. The issue of constructing and using fuzzy neural networks is considered.

## EDUCATIONAL CONTENT OF THE EDUCATIONAL DISCIPLINE

| **MODULE 1. Fuzzy Sets** | |
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| **Topic 1** | Classical Sets and Fuzzy Sets |
| **Topic 2** | Fuzzy Relations |

| Topic 3 | Properties of Membership Functions, Fuzzification, and Defuzzification |
|---------|------------------------------------------------------------------------|
| Topic 4 | Linguistic Hedges |
| **MODULE 2. Logic and Fuzzy Systems** | |
| Topic 5 | Other Forms of the Implication Operation |
| Topic 6 | Fuzzy (Rule-Based) Systems |
| Topic 7 | Development of Membership Functions. Neural Networks. Genetic Algorithms |
| Topic 8 | Automated Methods for Fuzzy Systems |
| Topic 9 | Fuzzy Control Systems |

## FORMS, METHODS AND EDUCATIONAL TECHNOLOGIES OF TEACHING

Learning and teaching methods: lectures, laboratory classes, e-learning using the Moodle system, testing, completing INDS tasks.

## FORMS AND METHODS OF CONTROL AND EVALUATION

**Types and forms of control**
1. Current (oral questioning, solving problems)
2. Modular (tests, laboratory work).
   **Assessment tools**: - tests; team projects; analytical reports on the performance of laboratory work, individual tasks and independent work.
**Final control** - exam.

## CRITERIA FOR ASSESSING LEARNING RESULTS

The system for assessing the level of educational achievements is based on the principles of ECTS and is cumulative. During the semester, students complete two tests and 4 laboratory works. Each test is evaluated with a maximum of 5 points, and laboratory works are evaluated with a maximum of 15 points. The final control in the discipline is an oral exam (40 points).

## POLICY ON ACADEMIC INTEGRITY

Adherence to the policy on academic integrity by participants in the educational process when studying an academic discipline is regulated by the following documents:

✓ «Code of Ethics of Yuriy Fedkovych Chernivtsi National University» https://www.chnu.edu.ua/media/jxdbs0zb/etychnyi-kodeks-chernivetskoho-natsionalnoho-universytetu.pdf
✓ «Regulations on the detection and prevention of academic plagiarism at Yuriy Fedkovych Chernivtsi National University» https://www.chnu.edu.ua/media/n5nbzwgb/polozhennia-chnu-pro-plahiat-2023 plusdodatky-31102023.pdf

# INFORMATION RESOURCES

1. Borisov, A. N. A theory of possibility for decision-making / A. N. Borisov, O. A. Krumberg // Fuzzy Sets and Systems. – 1983. – Vol. 9, № 1. – P. 34–38.

2. Altrock, C. Fuzzy logic. Bd. 2 : Technologie. – Munchen, BRD:
R. Oldenburg Verlag GmbH, 1994. – 375 p.

3. Bien, Z. An automatic start-up and shutdown control of drumtype boiler using fuzzy logic / Z. Bien, D. H. Hwang, J. H. Lee, H. K. Ryu // Proc. 2nd Int. Conf. on Fuzzy Logic and Neural Networks. II Zuka. – Japan. – 1992. – P. 465–468.

4. Hishida, N. Development of the operator support system applying fuzzy algorithms for glass tube molding equipment // Proc. 2nd Int. Conf. on Fuzzy Logic and Neural Networks. – Iizuka, Japan, 1992.
– P. 1097–1100.

5. Tobi, T. A practical application of fuzzy control for an airconditioning system / T. Tobi, T. Hanafusa // International Journal of Approximate Reasoning. – 1991.– № 5. – P. 331–348.

6. Fujiyoshi, M. A fuzzy automatic-combustion-control-system of refuse incineration plant / M. Fujiyoshi, T. A. Shiraki // Proc. 2nd Int. Conf. on Fuzzy Logic and Neural Networks. – Iizuka, Japan, 1992.
– P. 469–472.

7. Zadeh, L. A. Decision-making in a fuzzy environment / L. A. Zadeh, R. E. Bellman // Management. Sci. – 1970. – Vol. 17. – P. 141–164.

8. T. J. Ross Fuzzy Logic with Engineering Applications, Second Edition  – John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester,West Sussex PO19 8SQ, England –2004.

9. Cordon Oscar, Herrera Francisco, Hoffmann Frank, Magdalena Luis Genetic Fuzzy systems. Evolutionary tuning and learning of fuzzy knowledge bases. – World Scientific, 2001. – Singapore, New Jersey, London, Hong Kong. - 462