

DESCRIPTION/Syllabi of Curricula/Module

| Short Name of the University/Country code Date (Month / Year) | DSEA/P11 Sept 2020 |
|--|-----------------------|
| TITLE OF THE MODULE | Code |
| Methods of image processing and computer vision | 2.2.7 |

| Teacher(s) | Department |
|---|---|
| Coordinating: Liudmyla Vasylieva, PhD Others: Lina Bohadanova, PhD | Department of Computer and Information Technology (CIT) |

| Study cycle (BA/MA) | Level of the module (Semester number) | Type of the module (compulsary/elective) |
|------------------------|--|---|
| MA | 2st semester (first year) for Masters | Elective |

| Form of delivery (theory/lab/exercises) | Duration (weeks/months) | Language(s) |
|--|----------------------------|---------------------|
| Lectures, exercises | 18 weeks | Ukrainian / English |

| Prerequisites | |
|--|--|
| Prerequisites: study of the cycle of bachelor's degree disciplines in the specialty 122 "Computer Science" | Co-requisites (if necessary): Programming skills |

| ECTS (Credits of the module) | Total student workload hours | Contact hours | Individual work hours |
|---|--|--|-----------------------|
| 5,5 | 165 | 72 | 93 |
| Aim of the module (course unit): competences foreseen by the study programme | | | |
| <p>Students should be able:</p> <ul style="list-style-type: none"> - to provide the analysis of large data arrays, based on the information and data logical models, by using neural network technologies to solve data processing problems in subject areas. - to provide extraction of models from data and support of engineering activities, including through data processing, by applying methods and algorithms of deep learning, including using machine learning methods to solve classification and forecasting problems. | | | |
| Learning outcomes of module (course unit) | Teaching/learning methods (theory, lab, exercises) | Assessment methods (written exam, oral exam, reports) | |
| <p>Knowledge:</p> <ul style="list-style-type: none"> - advanced conceptual and methodological knowledge in the specialty 122 "Computer Science" and related specialties related to the receipt, transmission, and processing of information for various purposes, in technical, organizational, technical, and medical systems; - the ability to develop and research mathematical methods, models, and algorithms for data processing, apply mathematical methods to justify, optimize and make managerial and technical decisions adequate to the conditions in which informatization objects operate in various subject areas (technical, organizational, and technical, medical purposes, and etc.). | Working with lecture notes and basic literature on relevant topics | Knowledge test | |
| <p>Skills:</p> <ul style="list-style-type: none"> - possession of the skills of using a systematic approach, as a modern general scientific methodology for the integrated study of large and complex objects (systems) in the analysis, modeling, preparation, and conduct of an experiment, taking into account the peculiarities of systems of technical, organizational, technical, medical purposes, etc .; | Lectures, practical training, consultations | Active attendance of lectures, individual project and presentation | |

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|--|---|-------------------------------------|
| <p>- the ability to plan, design and carry out scientific research at the stage of conceptual formulation of the problem before critical assessment and consideration of the results and data obtained, including the ability to select or develop the necessary equipment, software, modern programming technologies, and research methods on systems of technical, organizational, technical, medical appointments and the like.</p> <p>- possession of skills in analysis, the use of mathematical methods for statistical processing, verification of the adequacy and interpretation of data obtained as a result of the study, including using artificial intelligence methods, and linking them with the relevant theory in the subject areas of technical, organizational, technical, medical appointments and the like.</p> | | |
| <p>Competences: study subject literature, share knowledge, work in groups</p> | Lectures, practical training, consultations | Individual project and presentation |

| Themes | Contact work hours | | | | | | | Time and tasks for individual work | |
|---|--------------------|---------------|----------|----------------|-----------------|------------|--------------------|------------------------------------|---|
| | Lectures | Consultations | Seminars | Practical work | Laboratory work | Placements | Total contact work | Individual work | Tasks |
| <p>1. Digital image processing (including biomedical). Packed matrix images. 24-bit binary RGB pixel representation. HLS and HSV color models. Addition and measurement of noise. Binary conversion and quantization. 1D histograms. Threshold processing. Inversion.</p> | 6 | | | 6 | | | 12 | 15 | Study exam/ complete design of practical work |

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|---|-----------|--|--|-----------|--|--|-----------|-----------|--|
| 2. Digital image processing (including biomedical). Geometric transformations of images. Functions of morphological processing. | 6 | | | 6 | | | 12 | 15 | Study exam/ complete design of practical work |
| 3. Digital image processing (including biomedical). Image edge detection. Segmentation. | 6 | | | 6 | | | 12 | 16 | Study exam/ complete design of practical work |
| 4. General characteristics of image recognition methods in computer vision systems. | 4 | | | 2 | | | 6 | 10 | Study exam/ complete design of practical work |
| 5. K-means method, and mean-shift method for object recognition | 4 | | | 2 | | | 6 | 10 | Study exam/ complete design of practical work |
| 6. Methods of tracking objects | 4 | | | 2 | | | 6 | 10 | Study exam/ complete design of practical work |
| 7. The use of convolutional neural networks to detect objects and highlight features | 6 | | | 12 | | | 18 | 17 | Study exam/ complete design of practical work |
| Total | 36 | | | 36 | | | 72 | 93 | |

| Assessment strategy | Weight in % | Deadlines | Assessment criteria |
|------------------------------|-------------|----------------------------|--|
| Written theory exam | 40% | during the semester / exam | good response to questions |
| Practical exam on a computer | 60% | during the semester / exam | the work is done completely without mistakes or minor errors |

| Author | Year of issue | Title | No of periodical or volume | Place of printing. Printing house or internet link |
|--------|---------------|-------|----------------------------|--|
| | | | | |

| Compulsory literature | | | | |
|---|------|---|--|--|
| Rafael C. Gonzalez, Richard E. Woods | 2017 | Digital Image Processing (4th Edition) | | ISBN: 0133356728 |
| Jeff Schewe | 2015 | The Digital Negative: Raw Image Processing in Lightroom, Camera Raw, and Photoshop (2nd Edition) | | ISBN: 0134033175 |
| Mark Nixon | 2012 | Feature Extraction and Image Processing for Computer Vision, Third Edition | | ISBN: 0123965497 |
| Maria Petrou, Costas Petrou | 2010 | Image Processing: The Fundamentals | | ISBN: 047074586X |
| Wilhelm Burger, Mark J. Burge | 2009 | Principles of Digital Image Processing: Core Algorithms (Undergraduate Topics in Computer Science) | | ISBN: 1848001940 |
| Prateek Joshi | 2019 | Artificial Intelligence with Python | | ISBN: 978-5-907114-41-8 |
| Forsyth D.A., Ponce J. | 2012 | Computer Vision: A Modern Approach | | ISBN: 013608592X 9780136085928 9780132848640 |
| Linda G. Shapiro, George Stockman | 2001 | Computer Vision | | ISBN: 978-0-13-030796-5 |
| Haykin S. | 1999 | Neural Networks and Learning Machines. | | ISBN-13: 978-0-13-147139-9 ISBN-10: 0-13-147139-2 |
| Additional literature | | | | |
| Ravishankar Chityala, Sridevi Pudipeddi | 2014 | Image Processing and Acquisition using Python (Chapman & Hall/CRC Mathematical and Computational Imaging Sciences Series) | | ISBN: 1466583754 |

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|--------------------|------|---|--|------------------------|
| John R. Jensen | 2015 | Principles of Digital Image Processing: Fundamental Techniques (Undergraduate Topics in Computer Science) | | ISBN: 013405816X |
| Julien Danjou | 2018 | Serious Python Black-Belt Advice on Deployment, Scalability, Testing, and More | | ISBN 978-1-59327-878-6 |
| Simon J. D. Prince | 2012 | Computer Vision: Models, Learning, and Inference | | ISBN 978-1-107-01179-3 |