Department \_ of environmental protection technologies and labor protection

Head of Department

Syllabus developer

KOTOVENKO O. /\_\_\_

#### 



# **SYLLABUS**

### Mathematical methods in ecology

| 1) Cipher according to the educational program 183                                     |  |
|--|--|
| <b>2) Academic year</b> 2023-2024  |  |
| 3) Educational level, second level of higher education (master's degree)               |  |
| 4) Study form full-time/external   |  |
| 5) Knowledge Field 18 Production and technologies                                      |  |
| 6) Speciality, educational program name  |  |
| Technologies of environmental protection   |  |
| 7) Educational component status optional   |  |
| 8) Semester 10 (2 <sub>M</sub> )   |  |
| 9) Teacher contact details associate professor Kotovenko O.,                           |  |
| kotovenko.oa@knuba.edu.ua, +380674644709,  |  |
| http://www.knuba.edu.ua/?page_id=45372   |  |
|  |  |
| <b>10)</b> Language of teaching Ukrainian  |  |
| 11) <b>Pre-requisites</b> higher mathematics, modeling and environment state           |  |
| forecasting, information technologies  |  |
| 12) <b>Purpose:</b> The discipline studying purpose is students acquire scientifically |  |
| based knowledge about mathematical methods for solving problems of nature              |  |
| management, modeling and environmental state forecasting, the evolutionary             |  |
| technogenesis development, which arise in ecology in connection with                   |  |
| anthropogenic environmental load.  |  |

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| Cipher of | Name of speciality, | Page 2 3 4 |
|-----------|---------------------|------------|
| specialty | educational program |            |
| 183       | Technologies of     |            |
|           | environmental       |            |
|           | protection          |            |

| № | Program study result   | Method of  | The form of                        | <b>Reference to</b>        |
|---|--|--|------------------------------------|----------------------------|
|   |  | checking<br>educational<br>effect                      | classes                            | competence                 |
|   | PR01. Analyze complex systems,<br>understand their relationships<br>and organizational structure.  | Discussion,<br>discussion<br>during classes,<br>report | Lectures                           | IC<br>GC 01,03,05<br>SC 02 |
|   | PR03. To use modern<br>communication and computer<br>technologies in the field of<br>environmental protection, to<br>collect, store, process and<br>analyze information about the<br>environment state and the<br>production sphere in order to<br>solve the professional activity<br>task   | Discussion,<br>discussion<br>during classes            | Lectures,<br>practical<br>classes  | IC<br>GC 01,03<br>SC 02    |
|   | PR04. To justify decisions aimed<br>at minimizing environmental<br>risks of economic activity at the<br>national, regional and local<br>levels.  | Discussion,<br>discussion<br>during classes            | Lectures ,<br>practical<br>classes | IC<br>GC 01,03<br>SC 02    |
|   | PR10. Assess the industrial facilities impact on the environment, the engineering activities consequences on the environment and the related responsibility for the decisions made, plan and conduct applied research on the problems of the industrial facilities impact on the environment | Individual task  | Lectures,<br>practical<br>classes  | IC<br>GC 01,03<br>SC 02    |
|   | PR15. Develop models, recommendations and forecasts, standards and other normative documents when designing technological processes in the conditions at global climate changes.   | Discussion,<br>discussion<br>during classes            | Lectures ,<br>practical<br>classes | IC<br>GC 01,03<br>SC 02    |

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| Cipher of | Name of speciality, | Page 3 3 4 |
|-----------|---------------------|------------|
| specialty | educational program |            |
| 183       | Technologies of     |            |
|           | environmental       |            |
|           | protection          |            |

| Lectures,<br>hours  | Practical<br>classes,<br>hours  | Laboratory<br>classes,<br>hours  | Course<br>project/ term<br>paper<br>CGW/ Control<br>work   | Independent<br>work of the<br>acquirer,<br>hours.   | Final control<br>form  |    |
|---|---|--|--|---|--|----|
| 20/12   | 10/6  |  | Individual<br>work   | 60/72   | test   |    |
| Sum of h  |   |  | 90/90  |   |  |    |
| Total nur<br>ECTS   | nber of cred  | lits   | 3/3  |   |  |    |
| The num   | ber of hours  |  | 30/18  |   |  |    |
| credits) o  | f classroom   | workload   |  |   |  | 30 |
| Lectures:   |   |  |  |   |  |    |
|   | module 1  | <b>Content module 1.</b> <i>Mathematical methods of approximate calculation and</i>  |  |   |  |    |
|   |   |  |  |   | toutation and  |    |
|   |   | solving enviro   | nmental problem  | ns  |  |    |
| Topic 1.  | Mathemati   | <i>solving enviro</i><br>ical methods o  | <i>nmental problem</i><br>f nonlinear equat  | <i>ns</i><br>tions approxi  | mate solution  |    |
| <b>Topic 1.</b><br>and their<br><b>Topic 2</b> .  | Mathemati<br>application<br>Methods o   | solving enviro<br>ical methods o<br>n in state envir<br>f linear equati  | nmental problem<br>f nonlinear equat<br>onmental mathe<br>ons systems app  | ns<br>tions approxin<br>matical mode<br>roximate solu   | mate solution<br>ling  |    |
| Topic 1.<br>and their<br>Topic 2.<br>application<br>Topic 3.  | Mathemati<br>application<br>Methods o<br>on in enviro<br>Methods o  | solving enviro<br>ical methods o<br><u>n in state envir</u><br>of linear equation<br>onmental state<br>of nonlinear equation   | nmental problem<br>f nonlinear equat<br>onmental mathe<br>ons systems app<br>mathematical m<br>quations systems  | ns<br>tions approxin<br>matical mode<br>roximate solu<br>odeling<br>s approximate   | mate solution<br>eling<br>ition and their<br>e solution and  |    |
| <b>Topic 1.</b><br>and their<br><b>Topic 2.</b><br>application<br><b>Topic 3</b><br>their app   | Mathemati<br>application<br>Methods o<br>on in enviro<br>Methods o<br>lication in e   | solving enviro<br>cal methods o<br><u>n in state envir</u><br>of linear equation<br>mental state<br>of nonlinear econvironmental   | nmental problem<br>f nonlinear equat<br>onmental mathe<br>ons systems app<br>mathematical m<br>quations systems<br>state mathemati   | ns<br>tions approxin<br><u>matical mode</u><br>roximate solu<br>odeling<br>s approximate<br>cal modeling  | mate solution<br>eling<br>ition and their<br>e solution and  |    |
| Topic 1.<br>and their<br>Topic 2.<br>application<br>Topic 3.<br>their app<br>Topic 4.   | Mathemati<br>application<br>Methods o<br>on in enviro<br>Methods o<br>Methods o   | solving enviro<br>cal methods o<br><u>in state envir</u><br>of linear equation<br>onmental state<br>of nonlinear equation<br>environmental<br>f numerical in   | nmental problem<br>f nonlinear equat<br>onmental mathe<br>ons systems app<br>mathematical m<br>quations systems<br>state mathemati<br>tegration of ordin   | ns<br>tions approxin<br>matical mode<br>roximate solu<br>odeling<br>s approximate<br>cal modeling<br>nary different   | mate solution<br>eling<br>ition and their<br>e solution and<br>ial equations   |    |
| Topic 1.<br>and their<br>Topic 2.<br>applicatio<br>Topic 3<br>their app<br>Topic 4.<br>and their  | Mathemati<br>application<br>Methods o<br>on in enviro<br>Methods o<br>lication in e<br>Methods o<br>application   | solving enviro<br>cal methods o<br><u>n in state envir</u><br>of linear equati<br>onmental state<br>of nonlinear equati<br>environmental<br>f numerical in<br>n in environme   | nmental problem<br>f nonlinear equat<br>onmental mathe<br>ons systems app<br>mathematical m<br>quations systems<br>state mathemati   | ns<br>tions approxin<br>matical mode<br>roximate solu<br>odeling<br>s approximate<br>cal modeling<br>nary different<br>matical mode   | mate solution<br>eling<br>ition and their<br>e solution and<br>ial equations<br>eling  |    |
| Topic 1.<br>and their<br>Topic 2.<br>applicatio<br>Topic 3.<br>their app<br>Topic 4.<br>and their<br>Topic 5<br>applicatio  | Mathemati<br>application<br>Methods of<br>Methods of<br>lication in e<br>Methods of<br>application<br>Approximon in enviro  | solving enviro<br>cal methods o<br><u>in state envir</u><br>of linear equation<br>onmental state<br>of nonlinear equation<br>of nonlinear equation<br>environmental<br>f numerical in<br><u>in environmental</u><br>nate solution<br>onmental state  | nmental problem<br>f nonlinear equations equations systems app<br>mathematical m<br>quations systems<br>state mathematic<br>tegration of ordinental state mathematic<br>a linear bounda<br>mathematical m  | ns<br>tions approxim<br>matical mode<br>roximate solu<br>odeling<br>s approximate<br>cal modeling<br>nary different<br>matical mode<br>ary value pro<br>odeling   | mate solution<br>eling<br>ition and their<br>e solution and<br>ial equations<br>eling<br>oblem and its   |    |
| Topic 1.<br>and their<br>Topic 2.<br>application<br>Topic 3.<br>their app<br>Topic 4.<br>and their<br>Topic 5.<br>application<br>Topic 6.   | Mathemati<br>application<br>Methods of<br>Methods of<br>lication in enviro<br>Methods of<br>application<br>Approxim<br>on in enviro<br>Methods of   | solving enviro<br>ical methods o<br><u>n in state envir</u><br>of linear equation<br>onmental state<br>of nonlinear equation<br>f numerical in<br><u>n in environmental</u><br>nate solution<br>onmental state<br>f numerical sol  | nmental problem<br>f nonlinear equations systems app<br>mathematical m<br>quations systems<br>state mathematic<br>tegration of ordinental state mathematic<br>a linear boundar<br>mathematical m<br>ution partial diff   | ns<br>tions approxim<br>matical mode<br>roximate solu<br>odeling<br>s approximate<br>cal modeling<br>nary different<br>matical mode<br>ary value pro<br>odeling<br>ferential equa   | mate solution<br>eling<br>ition and their<br>e solution and<br>ial equations<br>eling<br>oblem and its   |    |
| Topic 1.<br>and their<br>Topic 2.<br>applicatio<br>Topic 3.<br>their app<br>Topic 4.<br>and their<br>Topic 5<br>applicatio<br>Topic 6.<br>applicatio                              | Mathemati<br>application<br>Methods of<br>Methods of<br>lication in environ<br>Methods of<br>application<br>Approximon in environ<br>Methods of<br>on in environ  | solving enviro<br>cal methods o<br><u>in state envir</u><br>of linear equation<br>onmental state<br>of nonlinear equation<br>of nonlinear equation<br>f numerical in<br><u>in environmental</u><br>f numerical state<br>f numerical sol<br>onmental state  | nmental problem<br>f nonlinear equations systems app<br>mathematical m<br>quations systems<br>state mathematic<br>tegration of ordinental state mathematic<br>a linear bounda<br>mathematical m<br>ution partial diffi   | ns<br>tions approxim<br>matical mode<br>roximate solu<br>odeling<br>s approximate<br>cal modeling<br>nary different<br>matical mode<br>ary value pro<br>odeling<br>ferential equators<br>odeling                                  | mate solution<br>eling<br>ition and their<br>e solution and<br>ial equations<br>eling<br>oblem and its<br>tions and their                                      |    |
| Topic 1.<br>and their<br>Topic 2.<br>applicatio<br>Topic 3<br>their app<br>Topic 4.<br>and their<br>Topic 5<br>applicatio<br>Topic 6.<br>applicatio<br>Topic 7                    | Mathemati<br>application<br>Methods of<br>Methods of<br>lication in enviro<br>Methods of<br>application<br>Approxim<br>on in enviro<br>Methods of<br>on in enviro   | solving enviro<br>cal methods o<br><u>in state envir</u><br>of linear equation<br>onmental state<br>of nonlinear equation<br>of nonlinear equation<br>f numerical in<br><u>in environmental</u><br>f numerical in<br><u>onmental state</u><br>f numerical state<br>f numerical state<br>atical program                   | nmental problem<br>f nonlinear equation<br>onmental mather<br>ons systems app<br>mathematical m<br>quations systems<br>state mathematic<br>tegration of ordinental state mather<br>a linear boundar<br>mathematical m<br>ution partial diffi-<br>mathematical m<br>nming methods                         | ns<br>tions approxin<br>matical mode<br>roximate solu<br>odeling<br>s approximate<br>cal modeling<br>nary different<br>matical mode<br>ary value pro<br>odeling<br>erential equa<br>odeling<br>and their a                        | mate solution<br>eling<br>ition and their<br>e solution and<br>ial equations<br>eling<br>oblem and its<br>tions and their                                      |    |
| Topic 1.<br>and their<br>Topic 2.<br>application<br>Topic 3.<br>their app<br>Topic 4.<br>and their<br>Topic 5.<br>application<br>Topic 6.<br>application<br>Topic 7.<br>operation | Mathemati<br>application<br>Methods of<br>Methods of<br>lication in environ<br>Methods of<br>application<br>Approximon in environ<br>Methods of<br>on in environ<br>Methods of<br>on in environ<br>Methods of<br>on in environ<br>Methods of<br>on in environ | solving enviro<br>cal methods o<br><u>in state envir</u><br>of linear equati<br>onmental state<br>of nonlinear equation<br>of nonlinear equation<br>f numerical in<br><u>in environmental</u><br>f numerical in<br><u>onmental state</u><br>f numerical solution<br>onmental state<br>atical program<br>nodels for solvi | nmental problem<br>f nonlinear equation<br>onmental mather<br>ons systems app<br>mathematical m<br>quations systems<br>state mathematic<br>tegration of ordinental state mather<br>a linear boundar<br>mathematical m<br>ution partial difficult<br>mathematical m<br>nming methods<br>ing environmentar | ns<br>tions approxin<br>matical mode<br>roximate solu<br>odeling<br>s approximate<br>cal modeling<br>hary different<br>matical mode<br>ary value pro<br>odeling<br>cerential equation<br>odeling<br>and their a<br>al problems (r | mate solution<br>eling<br>ition and their<br>e solution and<br>ial equations<br>eling<br>oblem and its<br>tions and their<br>application in<br>rational nature |    |
| Topic 1.<br>and their<br>Topic 2.<br>application<br>Topic 3.<br>their app<br>Topic 4.<br>and their<br>Topic 5<br>application<br>Topic 6.<br>application<br>Topic 7<br>operation   | Mathemati<br>application<br>Methods of<br>Methods of<br>lication in environ<br>Methods of<br>application<br>Approximon in environ<br>Methods of<br>on in environ<br>Methods of<br>on in environ<br>Methods of<br>on in environ<br>Methods of<br>on in environ | solving enviro<br>cal methods o<br><u>in state envir</u><br>of linear equati<br>onmental state<br>of nonlinear equation<br>of nonlinear equation<br>f numerical in<br><u>in environmental</u><br>f numerical in<br><u>onmental state</u><br>f numerical solution<br>onmental state<br>atical program<br>nodels for solvi | nmental problem<br>f nonlinear equation<br>onmental mather<br>ons systems app<br>mathematical m<br>quations systems<br>state mathematic<br>tegration of ordinental state mather<br>a linear boundar<br>mathematical m<br>ution partial diffi-<br>mathematical m<br>nming methods                         | ns<br>tions approxin<br>matical mode<br>roximate solu<br>odeling<br>s approximate<br>cal modeling<br>hary different<br>matical mode<br>ary value pro<br>odeling<br>cerential equation<br>odeling<br>and their a<br>al problems (r | mate solution<br>eling<br>ition and their<br>e solution and<br>ial equations<br>eling<br>oblem and its<br>tions and their<br>application in<br>rational nature |    |

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| Cipher of | Name of speciality, | Page 4 3 4 |
|-----------|---------------------|------------|
| specialty | educational program |            |
| 183       | Technologies of     |            |
|           | environmental       |            |
|           | protection          |            |

| I           | Practical classes:  |
|-------------|---|
|             | Numerical solution nonlinear equations  |
| 2           | Numerical solution systems linear algebraic equations   |
| 3           | Numerical solution systems nonlinear algebraic equations.   |
| 1           | Numerical solution ordinary differential equations  |
| (           | Course project/ term paperCGW/ Control work   |
| (<br>\<br>\ | CGW. Application approximate methods solving linear boundary<br>value problems and numerical methods solving partial differential<br>equations for specific ecological models   |
|             | ndividual work:   |
|             | <ol> <li>Mastering the lecture material</li> <li>Preparation for practical classes and individual work under the guidance of<br/>the teacher</li> <li>Defense of on individual teach</li> </ol>   |
|             | <ol> <li>Performance of an individual task</li> <li>Work with literature and electronic media</li> </ol>  |
| ┢           | 4. WORK with merature and electronic media  |
| ₹)Li        | terature:   |
| <i></i>     | Methodic literature   |
| 2.          | Navchal'nyj posibnyk (u 2 chastynakh) dlia studentiv spetsial'nosti 101 «Ekolohiia»,<br>183 «Tekhnolohii zakhystu navkolyshn'oho seredovyscha» / Chastyna 1.<br>Matematychni metody nablyzhenoho obchyslennia ta ikh zastosuvannia pry<br>vyrishenni ekolohichnykh zadach. Kyiv: KNUBA, 2019. 48 s.<br>Matematychni metody v ekolohii: Metodychni vkazivky do vykonannia<br>praktychnykh robit dlia studentiv spetsial'nosti/ O.A. Kotovenko, L.I. Sobolevs'ka,<br>O.Yu. Miroshnychenko, O.V. Hapula. Kyiv:KNUBA, 2007. 32 s. (Onovleno v<br>elektronnomu vyhliadi u 2020 r.)<br><b>Basic</b> |
| Dro         |   |
| pro         | <i>novyts'ka S.V., Medvedev R.B., Fialkov Yu.Ya.</i> Obchysliuval'na matematyka ta hramuvannia : Obchysl. matematyka v khimii i khim. tekhnolohii: Pidruch. dlia stud. ntekhnol. spets. vysch. navch. zakl. Kyiv: Politekhnika NTUU "KPI"; Periodyka, 4.  |
| Der         | nedovych V.P., Maran Y.A., Osnovy vychyslytel'noj matematyky. Nauka, 1970. 664  |
|             | arykyn V.M., Zhytomyrskyj V.H., Lapchyk M.P. Chyslennye metody. Prosveschenye, 0. 170 s.  |
| Wagi        | ner, H. Principles of Operations Research, 2d ed. En  |
| И. М        | <i>lynu</i> Matematycheskoe prohrammyrovanye. Teoryia y alhorytmy. Nauka Hl. red  |

5. *M. Mynu* Matematycheskoe prohrammyrovanye. Teoryia y alhorytmy. Nauka Hl. red.. fyz-mat. lyt 1990. 480 s. ISBN 5-02-013980-7