

## SYLLABUS

### 1. Information regarding the programme

|                                     |                                                             |
|-------------------------------------|-------------------------------------------------------------|
| 1.1 Higher education institution    | <b>Babeş-Bolyai University of Cluj-Napoca</b>               |
| 1.2 Faculty                         | <b>Faculty of Environmental Science and Engineering</b>     |
| 1.3 Department                      | <b>Department of Environmental Analysis and Engineering</b> |
| 1.4 Field of study                  | <b>Environmental Engineering</b>                            |
| 1.5 Study cycle                     | <b>Bachelor</b>                                             |
| 1.6 Study programme / Qualification | <b>Environmental Engineering</b>                            |

### 2. Information regarding the discipline

|                            |                      |              |   |                         |       |                        |           |
|----------------------------|----------------------|--------------|---|-------------------------|-------|------------------------|-----------|
| 2.1 Name of the discipline | Alternative energies |              |   |                         |       |                        |           |
| 2.2 Course coordinator     | Dr. Giuseppe Etiope  |              |   |                         |       |                        |           |
| 2.3 Seminar coordinator    | Dr. Giuseppe Etiope  |              |   |                         |       |                        |           |
| 2.4 Year of study          | IV                   | 2.5 Semester | 7 | 2.6. Type of evaluation | Exam. | 2.7 Type of discipline | Mandatory |

### 3. Total estimated time (hours/semester of didactic activities)

|                                                                                       |    |                      |    |                        |       |
|---------------------------------------------------------------------------------------|----|----------------------|----|------------------------|-------|
| 3.1 Hours per week                                                                    | 4  | 3.2 Of which: course | 2  | 3.3 Seminar/laboratory | 2     |
| 3.4 Total hours in the curriculum                                                     | 56 | 3.5 Of which: course | 28 | 3.6 Seminar/Laboratory | 28    |
| Time allotment:                                                                       |    |                      |    |                        | Hours |
| Learning using manual, course support, bibliography, course notes                     |    |                      |    |                        | 12    |
| Additional documentation (in libraries, on electronic platforms, field documentation) |    |                      |    |                        | 12    |
| Preparation for seminars/labs, homework, papers, portfolios and essays                |    |                      |    |                        | 12    |
| Tutorship                                                                             |    |                      |    |                        | 4     |
| Evaluations                                                                           |    |                      |    |                        | 2     |
| Other activities: .....                                                               |    |                      |    |                        |       |
| 3.7 Total individual study hours                                                      | 42 |                      |    |                        |       |
| 3.8 Total hours per semester                                                          | 98 |                      |    |                        |       |
| 3.9 Number of ECTS credits                                                            | 4  |                      |    |                        |       |

### 4. Preconditions (if necessary)

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|------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 4.1 Curriculum   | <ul style="list-style-type: none"> <li>Physics, Mathematics, High School Chemistry</li> </ul>                               |
| 4.2 Competencies | <ul style="list-style-type: none"> <li>Corresponding competencies in Physics, Mathematics, Chemistry High School</li> </ul> |

### 5. Conditions (if necessary)

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|---------------------|-----------------------------------------------------------------|
| 5.1. for the course | <ul style="list-style-type: none"> <li>No conditions</li> </ul> |
|---------------------|-----------------------------------------------------------------|

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|--------------------------------------|----------------------------------------------------------------------|
| 5.2. for the seminar /lab activities | <ul style="list-style-type: none"> <li>Physics Laboratory</li> </ul> |
|--------------------------------------|----------------------------------------------------------------------|

## 6. Specific competencies acquired

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|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Professional competencies | <ul style="list-style-type: none"> <li>Knowledge of the current energy situation</li> <li>Knowledge of the types of renewable energies</li> <li>Knowledge of the advantages/disadvantages of types of renewable energies</li> <li>Knowledge of energy-saving methods</li> </ul>                                                                                 |
| Transversal competencies  | <ul style="list-style-type: none"> <li>Developing the ability to use the acquired knowledge in practical applications and the ability to solve specific problems</li> <li>Mathematics, science and technology skills</li> <li>Teamwork skills</li> <li>Development of critical reasoning, based on performing and interpreting quantitative analyses</li> </ul> |

## 7. Objectives of the discipline (outcome of the acquired competencies)

|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7.1 General objective of the discipline | Presentation of the state of energy resources at present, the awareness of the need for alternative energy sources; presentation of the types of renewable energies, with the advantages and disadvantages of each                                                                                                                                                                                                                                          |
| 7.2 Specific objectives                 | <ol style="list-style-type: none"> <li>The standard energy source of today's human society is presented: Electricity</li> <li>Solar energy: photovoltaic and thermal panels</li> <li>Wind Energy: Wind Turbines</li> <li>Water energy: hydro, sea currents, waves, and tides, geothermal</li> <li>Biomass energy: biodiesel, bioethanol, biogas</li> <li>Fuel cells and hydrogen</li> <li>Nuclear energy</li> <li>Global warming, Kyoto Protocol</li> </ol> |

## 8. Content

| 8.1 Course                                                                                                                                                                                   | Teaching methods                                                                                                     | Remarks |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------|
| <b>1. What is renewable energy?</b> [2 hours]<br><br><b>Basic concepts:</b> standard energy = electricity, renewable energy, industrial revolution, CO2<br><br><b>Bibliography:</b> [1], [2] | Interactive lecture<br>Exposure<br>Problematization<br>Exercises and problem solving<br>Presentation of case studies |         |
| <b>2. The Sun - the main source of energy of mankind</b> [2 hours]                                                                                                                           | Heuristic conversation<br>Explanation<br>Modeling                                                                    |         |

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| <p><b>Basic concepts:</b> physical characteristics of the sun, proton-proton reaction, electromagnetic waves, solar constant, solar spectrum</p> <p><b>Bibliography:</b> [1], [2]</p>                               |  |  |
| <p><b>3. Solar energy capture: photovoltaic cell</b> [2 hours]</p> <p><b>Basic concepts:</b> p-n junction, fill factor, no-load voltage, short-circuit current, efficiency</p> <p><b>Bibliography:</b> [1], [2]</p> |  |  |
| <p><b>4. Applications of photovoltaic solar cells</b> [2 hours]</p> <p><b>Basic concepts:</b> characteristics of sunlight, air factor, on-grid, off-grid mounting</p> <p><b>Bibliography:</b>[1], [2]</p>           |  |  |
| <p><b>5. High Power Solar Power Plants</b> [2 hours]</p> <p><b>Basic concepts:</b> parabolic mirrors, tower power, Stirling engine</p> <p><b>Bibliography:</b> [1], [2]</p>                                         |  |  |
| <p><b>6. Wind energy</b> [2 hours]</p> <p><b>Basic concepts:</b> wind categories, wind turbine, Stall effect, Pitch, wind farms</p> <p><b>Bibliography.</b> [1]</p>                                                 |  |  |
| <p><b>7. Water Energy</b> [2 hours]</p> <p><b>Basic concepts:</b> hydro-energy, wave energy, marine currents</p> <p><b>Bibliography.</b> [1]</p>                                                                    |  |  |
| <p><b>8. Geothermal energy</b> [2 hours].</p> <p><b>Basic concepts:</b> geothermal energy extraction engines, and use of geothermal energy [1].</p>                                                                 |  |  |
| <p><b>9. Heat pumps; Recovery of heat energy from sewerage</b> [2 hours].</p> <p><b>Basic concepts:</b> heat pump [1]</p>                                                                                           |  |  |
| <p><b>10. Biomass</b> [2hrs]</p> <p><b>Basic concepts:</b> biodiesel, bioethanol, biogas [1], [2]</p>                                                                                                               |  |  |
| <p><b>11. Fuel cells, hydrogen</b> [2 hours]</p> <p><b>Basic concepts:</b> the principle of operation of the fuel cell, applications [7]</p>                                                                        |  |  |
| <p><b>12. Nuclear energy</b> [2 hours]</p> <p><b>Basic concepts:</b> fission, nuclear fusion [1],[2]</p>                                                                                                            |  |  |
| <p><b>13. Energy reserves, consumption, alternatives</b> [2 hours]</p> <p><b>Basic concepts:</b> <i>peak oil, peak gas, peak coal</i> [1]</p>                                                                       |  |  |

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------|
| <b>14 Global warming, Kyoto Protocol, renewable energies</b> [2 hours] [1]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                |
| Bibliography<br>1. Baican R., Renewable Energies, Grinta Publishing House, 2010, Cluj-Napoca<br>2. Letcher T.M., Future Energy, Elsevier, 2007                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                         |                |
| <b>8.2 Seminar / laboratory</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Teaching methods</b> | <b>Remarks</b> |
| 1. Project no.1 – Estimating the monthly household electricity consumption for a house [2 hours]<br>2. Project no.2 – Estimating the potential of solar radiation on the territory of Romania [2 hours]<br>3. Project no. 3-Design of a solar power plant with photovoltaic modules [4 hours]<br>4. Project no. 4- Calculation of the efficiency of a heat pump [2 hours]<br>6., 7. Construction and characterization of a microbial combustion cell [4 hours]<br>8., 9, 10. Determination of the technical characteristics of a photovoltaic panel [6 hours]<br>11, 12. Determination of the operating parameters of a parabolic mirror heating system [4 hours]<br>13. Stirling Engine Study [2 hours]<br>14. Fuel cell study [2 hours] |                         |                |
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**9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations, and representative employers within the field of the program**

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**10. Evaluation**

| Type of activity                                                                                                                                                    | 10.1 Evaluation criteria                                         | 10.2 Evaluation methods       | 10.3 Share in the final grade |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-------------------------------|-------------------------------|
| 10.4 Course                                                                                                                                                         | Correctness of the answer                                        | Oral exam                     | 60%                           |
|                                                                                                                                                                     |                                                                  |                               |                               |
| 10.5 Seminar/laboratory                                                                                                                                             | Data collection and correct interpretation<br>Synthesis capacity | Grading projects and lab work | 40%                           |
|                                                                                                                                                                     |                                                                  |                               |                               |
| 10.6 Minimum performance standards                                                                                                                                  |                                                                  |                               |                               |
| <ul style="list-style-type: none"> <li>The student should know the theoretical foundation of the phenomena, to operate with specific measuring equipment</li> </ul> |                                                                  |                               |                               |

Date of completion      Signature of the course coordinator

06 12 2024

Dr. Giuseppe Etiope



Signature of the seminar coordinator

Dr. Giuseppe Etiope



Date of approval in the department

Signature of the head of the department