## **COURSE DESCRIPTION CARD**

| Faculty of Electrical Engineering    |   |  |         |        |          |        |                                 |                     |               |  |  |
|--------------------------------------|---|--|---------|--------|----------|--------|---------------------------------|---------------------|---------------|--|--|
| Field of study                       |   | E  | lectric | al Eng | ineerir  | ng     | Degree level and programme type | Bachelor's degree   |               |  |  |
| Specialization/<br>diploma path      |   |  |         | -      |          |        | Study profile                   | -                   |               |  |  |
| Course name                          | Renewable Energy Technologies   |  |         |        |          |        |                                 | Course code         | IS-FEE-10078S |  |  |
|                                      | '   | COLICAN  | abie L  | ileigy | i ecilii | ologie | Course type elective            |                     |               |  |  |
| Forms and number of hours of tuition | L   | С  | LC      | Р      | sw       | FW     | S                               | Semester            | summer        |  |  |
|                                      | 30  |  |         |        |          |        |                                 | No. of ECTS credits | 3             |  |  |
| Entry requirements                   | -   |  |         |        |          |        |                                 |                     |               |  |  |
| Course<br>objectives                 | This module will introduce students to various renewable energy resources and technologies used for harnessing them. Students will also be able to understand introductory concepts of economics surrounding renewable energy system.   |  |         |        |          |        |                                 |                     |               |  |  |
| Course content                       | Power system structure, systems for converting various forms of energy into electricity. Primary energy sources and processing systems. Hydro, Wind, Solar photovoltaic, Biomass and Geothermal Energy resources. Construction, operating principle, basic functional characteristics of these RES. Storage systems. Energy economics surrounding RES, costs, and pricing scheme. |  |         |        |          |        |                                 |                     |               |  |  |
| Teaching methods                     | Lectures with the support of media (video) and assignments.   |  |         |        |          |        |                                 |                     |               |  |  |
| Assessment method                    | Assignments during the semester and a written test at the end of the semester.  |  |         |        |          |        |                                 |                     |               |  |  |
| Symbol of learning outcome           | Reference to the Learning outcomes learning outcomes for the field of study   |  |         |        |          |        |                                 |                     |               |  |  |
| L01                                  | Understand power system structure and the distinction between renewable and non-renewable energy sources.   |  |         |        |          |        |                                 |                     |               |  |  |
| LO2                                  | Understand global scenario involving energy demand and the need for renewable energy.   |  |         |        |          |        |                                 |                     |               |  |  |
| LO3                                  |   | ain RE<br>hermal   |         | nologi | es: Hyd  | dro, W | ind, S                          | olar, Biomass and   |               |  |  |
| LO4                                  |   | Compare various RES technologies and identify the most suitable technology based on local conditions |         |        |          |        |                                 |                     |               |  |  |
| LO5                                  | Discu   | uss the  |         | rtance |          |        |                                 | S and the latest    |               |  |  |
| LO6                                  | Understand energy costs including LCOE, LCC etc and   |  |         |        |          |        |                                 |                     |               |  |  |

| Symbol of learning outcome   Methods of assessing the learning outcomes   Type of tuition during which the outcome is assessed   |                 | describe various pricing scheme surrounding RES.   |                      |              |  |  |  |  |  |
|--|-----------------|--|----------------------|--------------|--|--|--|--|--|
| LO2 Assignments and test based on the lecture LO3 Assignments and test based on the lecture LO4 Assignments and test based on the lecture LO5 Assignments and test based on the lecture LO6 Assignments and test based on the lecture LO6 Assignments and test based on the lecture LO7 Assignments and test based on the lecture LO8 Assignments and test based on the lecture LO8 Assignments and test based on the lecture LO9 Assignments and te | learning        | Methods of assessing the learning outcomes   | which the outcome is |              |  |  |  |  |  |
| LO3  | L01             | Assignments and test based on the lecture  | L                    |              |  |  |  |  |  |
| LO4 Assignments and test based on the lecture LO5 Assignments and test based on the lecture LO6 Student workload (in hours) No. of hours    Class attendance   | LO2             | Assignments and test based on the lecture  | L                    |              |  |  |  |  |  |
| LO5 Assignments and test based on the lecture L  Student workload (in hours) No. of hours  Class attendance 30 Assignments and self-study 30 Preparation and write tests 15  Calculation  TOTAL: 75  Quantitative indicators HOURS ECTS credits  Student workload – activities that require direct teacher participation 30 1.5  Student workload – practical activities 45 1.5  Student workload – practical activities 45 1.5  1. John Twidell and Tony Weir, "Renewable Energy Resources", 3rd edition, Taylor & Francis, 2015. 2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", 2nd edition, Wiley-IEEE Press, 2013. 3. Aldo da Rosa, "Fundamentals of Renewable Energy Processes", Academic Press, 2005. 4. Francis M. Vanek, Louis D. Albright, and Largus T. Angenent, "Energy Systems Engineering: Evaluation and Implementation", 3rd edition, McGraw Hill, 2016. 1. Bent Sorensen, "Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017. 2. B.K. Hodge, "Alternative Energy Systems & Applications", 2nd edition, Wiley, 2017. 3. Godfrey Boyle, "Renewable Energy: Physics Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017. 2. B.K. Hodge, "Alternative Energy Systems & Applications", 2nd edition, Wiley, 2017. 3. Godfrey Boyle, "Renewable Energy: Physics Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017. 3. Godfrey Boyle, "Renewable Energy: Physics Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017. 3. Godfrey Boyle, "Renewable Energy: Physics Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017. 3. Godfrey Boyle, "Renewable Energy: Physics Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017. 4. Bent Sorensen, Tenewable Energy: Physics Engineering, Environmental Impacts, Economics and Planning", 5 | LO3             | Assignments and test based on the lecture  | L                    |              |  |  |  |  |  |
| Calculation      | LO4             | Assignments and test based on the lecture  | L                    |              |  |  |  |  |  |
| Class attendance   30     Assignments and self-study   30     Preparation and write tests   15     TOTAL:   75     Quantitative indicators   HOURS   ECTS credits     Student workload – activities that require direct teacher participation   30   1.5   | LO5             | Assignments and test based on the lecture  | L                    |              |  |  |  |  |  |
| Calculation  TOTAL:  Total: T | LO6             | Assignments and test based on the lecture  | L                    |              |  |  |  |  |  |
| Assignments and self-study Preparation and write tests  TOTAL:  TOTAL:  Quantitative indicators  ROURS  Student workload – activities that require direct teacher participation  Student workload – practical activities  45  1. John Twidell and Tony Weir, "Renewable Energy Resources", 3rd edition, Taylor & Francis, 2015.  2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", 2rd edition, Wiley-IEEE Press, 2013.  3. Aldo da Rosa, "Fundamentals of Renewable Energy Processes", Academic Press, 2005.  4. Francis M. Vanek, Louis D. Albright, and Largus T. Angenent, "Energy Systems Engineering: Evaluation and Implementation", 3rd edition, McGraw Hill, 2016.  Supplementary references  1. Bent Sorensen, "Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017.  2. B.K. Hodge, "Alternative Energy Systems & Applications", 2rd edition, Wiley, 2017.  3. Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future", 3rd edition, Oxford University Press, 2012.  Department of Electrotechnics, Power Electronics and Power Engineering  Date of issuing the programme  Author of the   |                 | Student workload (in hours)  |                      | No. of hours |  |  |  |  |  |
| Preparation and write tests 15  Calculation  Quantitative indicators TOTAL: 75  Quantitative indicators HOURS ECTS credits  Student workload – activities that require direct teacher participation 30 1.5  Student workload – practical activities 45 1.5  1. John Twidell and Tony Weir, "Renewable Energy Resources", 3rd edition, Taylor & Francis, 2015. 2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", 2rd edition, Wiley-IEEE Press, 2013. 3. Aldo da Rosa, "Fundamentals of Renewable Energy Processes", Academic Press, 2005. 4. Francis M. Vanek, Louis D. Albright, and Largus T. Angenent, "Energy Systems Engineering: Evaluation and Implementation", 3rd edition, McGraw Hill, 2016.  Supplementary references 1. Bent Sorensen, "Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017. 2. B.K. Hodge, "Alternative Energy Systems & Applications", 2rd edition, Wiley, 2017. 3. Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future", 3rd edition, Oxford University Press, 2012.  Department of Electrotechnics, Power Electronics and Power Engineering  Date of issuing the programme  Author of the   |                 | Class attendance   | 30                   |              |  |  |  |  |  |
| Calculation    TOTAL:   75   No. of ECTS   ECTS   Credits  |                 | Assignments and self-study   | 30                   |              |  |  |  |  |  |
| TOTAL: 75   Quantitative indicators  |                 | Preparation and write tests  | 15                   |              |  |  |  |  |  |
| Rountitative indicators   Hours   Rounditative   Care   Care   Care  | Calculation     |  |                      |              |  |  |  |  |  |
| Rountitative indicators   Hours   Rounditative   Care   Care   Care  |                 |  |                      |              |  |  |  |  |  |
| Student workload – activities that require direct teacher participation  Student workload – practical activities  45 1.5  Student workload – practical activities  45 1.5  Student workload – practical activities  45 1.5  As a label of Erancis, 2015.  2. Gilbert M. Masters, "Renewable Energy Resources", 3rd edition, Taylor & Francis, 2015.  2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", 2rd edition, Wiley-IEEE Press, 2013.  3. Aldo da Rosa, "Fundamentals of Renewable Energy Processes", Academic Press, 2005.  4. Francis M. Vanek, Louis D. Albright, and Largus T. Angenent, "Energy Systems Engineering: Evaluation and Implementation", 3rd edition, McGraw Hill, 2016.  Supplementary references  1. Bent Sorensen, "Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017.  2. B.K. Hodge, "Alternative Energy Systems & Applications", 2rd edition, Wiley, 2017.  3. Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future", 3rd edition, Oxford University Press, 2012.  Department of Electrotechnics, Power Electronics and Power Engineering  Date of issuing the programme  Author of the   |                 | TOTAL:   | 75                   |              |  |  |  |  |  |
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| Basic references  Basic references  1. John Twidell and Tony Weir, "Renewable Energy Resources", 3rd edition, Taylor & Francis, 2015.  2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", 2nd edition, Wiley-IEEE Press, 2013.  3. Aldo da Rosa, "Fundamentals of Renewable Energy Processes", Academic Press, 2005.  4. Francis M. Vanek, Louis D. Albright, and Largus T. Angenent, "Energy Systems Engineering: Evaluation and Implementation", 3rd edition, McGraw Hill, 2016.  1. Bent Sorensen, "Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017.  2. B.K. Hodge, "Alternative Energy Systems & Applications", 2nd edition, Wiley, 2017.  3. Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future", 3rd edition, Oxford University Press, 2012.  Department of Electrotechnics, Power Electronics and Power Engineering  Date of issuing the programme  Andu Dukpa, PhD  20.1.2022  | Student worl    | Student workload – activities that require direct teacher participation  |                      |              |  |  |  |  |  |
| Francis, 2015.  2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", 2nd edition, Wiley-IEEE Press, 2013.  3. Aldo da Rosa, "Fundamentals of Renewable Energy Processes", Academic Press, 2005.  4. Francis M. Vanek, Louis D. Albright, and Largus T. Angenent, "Energy Systems Engineering: Evaluation and Implementation", 3nd edition, McGraw Hill, 2016.  1. Bent Sorensen, "Renewable Energy: Physics, Engineering, Environmental Impacts, Economics and Planning", 5th Edition, Elsevier Academic Press, 2017.  2. B.K. Hodge, "Alternative Energy Systems & Applications", 2nd edition, Wiley, 2017.  3. Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future", 3nd edition, Oxford University Press, 2012.  Department of Electrotechnics, Power Electronics and Power Engineering  Date of issuing the programme  Andu Dukpa, PhD  20.1.2022   |                 | Student workload – practical activities  |                      |              |  |  |  |  |  |
| Supplementary references  Economics and Planning", 5th Edition, Elsevier Academic Press, 2017.  B.K. Hodge, "Alternative Energy Systems & Applications", 2nd edition, Wiley, 2017.  Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future", 3rd edition, Oxford University Press, 2012.  Department of Electrotechnics, Power Electronics and Power Engineering  Date of issuing the programme  Andu Dukpa, PhD  20.1.2022  |                 | <ol> <li>Francis, 2015.</li> <li>Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", 2<sup>nd</sup> edition, Wiley-IEEE Press, 2013.</li> <li>Aldo da Rosa, "Fundamentals of Renewable Energy Processes", Academic Press, 2005.</li> <li>Francis M. Vanek, Louis D. Albright, and Largus T. Angenent, "Energy Systems</li> </ol> |                      |              |  |  |  |  |  |
| unit conducting the course Author of the Andu Dukpa. PhD Department of Electrotechnics, Power Electronics page programme programme   | references      | Economics and Planning", 5 <sup>th</sup> Edition, Elsevier Academic Press, 2017.  2. B.K. Hodge, "Alternative Energy Systems & Applications", 2 <sup>nd</sup> edition, Wiley, 2017.  3. Godfrey Boyle, "Renewable Energy: Power for a Sustainable Future", 3 <sup>rd</sup> edition,  |                      |              |  |  |  |  |  |
| Andu Dukpa. PhD 20.1.2022  | unit conducting | -  |                      |              |  |  |  |  |  |
|  |                 | Andu Dukpa, PhD  | 20.1.2022            |              |  |  |  |  |  |

L - lecture, C - classes, LC - laboratory classes, P - project, SW - specialization workshop, FW - field work,