



## Electrical and Renewable Energy Engineering Program

### Course Specification - (2025-2026)

#### Fundamentals of Photovoltaic – ERE212

|               |           |          |      |
|---------------|-----------|----------|------|
| Academic Year | 2025/2026 | Semester | Fall |
|---------------|-----------|----------|------|

#### 1. Basic Information

|                                                                      |                                                                                |               |          |                 |       |
|----------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------|----------|-----------------|-------|
| Course Title (according to the bylaw)                                | Fundamentals of Photovoltaic                                                   |               |          |                 |       |
| Course Code (according to the bylaw)                                 | ERE212                                                                         |               |          |                 |       |
| Prerequisite:                                                        | Electronic Devices - CCE122                                                    |               |          |                 |       |
| Department/s participating in delivery of the course                 | Electrical and Renewable Energy Engineering                                    |               |          |                 |       |
| Number of credit hours/points of the course (according to the bylaw) | Credit Hours                                                                   | Contact Hours |          |                 |       |
|                                                                      |                                                                                | Lecture       | Tutorial | Practical       | Total |
|                                                                      | 3                                                                              | 2             | 1        | 2               | 5     |
| Course Type                                                          | Compulsory - Minor Requirements of Electrical and Renewable Energy Engineering |               |          |                 |       |
| Academic level at which the course is taught                         | Third Level                                                                    |               |          |                 |       |
| Academic Program                                                     | Bachelor of Engineering of Electrical and Renewable Energy                     |               |          |                 |       |
| Faculty/Institute                                                    | Faculty of Engineering                                                         |               |          |                 |       |
| University/Academy                                                   | Nahda University                                                               |               |          |                 |       |
| Name of Course Coordinator                                           | Dr. Beshoy Abdou Aziz                                                          |               |          |                 |       |
| Course Specification Approval:                                       | Department council                                                             |               |          | Faculty council |       |
| Date of Approval of the course Specification:                        | 13 / 9 / 2025                                                                  |               |          | 16 / 9 / 2025   |       |



## 2. Course Overview

Sunlight energy, Energy conversion, Solar radiation measurement, Principles of solar cell operation, structure, electrical and optical characteristics, equivalent circuit, Crystalline silicon solar cells, Thin film technologies for PV, building integrated PV (BIPV), Energy production by a PV array, Energy balance in stand-alone PV systems, the estimated cost and payback times for the various technologies, the advantages and disadvantages of each type, feed-in tariffs and other incentives, Standards, calibration and testing of PV modules and solar cells, PV system monitoring. Safety considerations in PV system. Site assessment. System design and sizing. Maximizing cell efficiency. Social and environment aspects of PV systems. Basics of testing and maintaining major components of a PV system.

## 3. Course Learning Outcomes CLOs

### Matrix of course learning outcomes CLOs with program outcomes POs (NARS/ARS)

| Program Outcomes (NARS/ARS)<br>(according to the matrix in the program specs) |                                                                                                                                                                                                                                    | Course Learning Outcomes<br>Upon completion of the course, the student will be able to: |                                                                                                                                                                                           |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Code                                                                          | Text                                                                                                                                                                                                                               | Code                                                                                    | Text                                                                                                                                                                                      |
| A2                                                                            | Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions.                  | CLO6                                                                                    | Develop simulation to size both standalone and grid-connected photovoltaic systems using any software packages.                                                                           |
| B1                                                                            | Select, model and analyze electrical power systems applicable to the Electrical Power and Program by Renewable Energy Engineering applying the concepts of: generation, transmission and distribution of electrical power systems. | CLO3                                                                                    | Analyze the equivalent circuit of photovoltaic cell to obtain the voltage and current at the maximum power point.                                                                         |
| D2                                                                            | Identify, analyze and evaluate the energy's conversion processes and management techniques.                                                                                                                                        | CLO1                                                                                    | Recognize sunlight energy, energy conversion, solar radiation measurement, principles of solar cell operation, structure, electrical and optical characteristics, and crystalline silicon |



| Program Outcomes (NARS/ARS)<br>(according to the matrix in the program specs) |                                                                                                                                                                                                                  | Course Learning Outcomes<br>Upon completion of the course, the student will be able to: |                                                                                                                 |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Code                                                                          | Text                                                                                                                                                                                                             | Code                                                                                    | Text                                                                                                            |
|                                                                               |                                                                                                                                                                                                                  |                                                                                         | solar cells and thin film technologies for PV.                                                                  |
| D3                                                                            | Model, analyze, design, implement, test and operate renewable energy systems such as solar photovoltaics, solar thermal, wind, biomass and waste, hydro-tidal and wave, and other renewable energy applications. | CLO4                                                                                    | Design a specific system of solar photovoltaic power generation for stand-alone applications.                   |
|                                                                               |                                                                                                                                                                                                                  | CLO5                                                                                    | Design a specific system of solar photovoltaic power generation for grid-connected applications.                |
|                                                                               |                                                                                                                                                                                                                  | CLO2                                                                                    | Perform calibration and testing of PV modules and solar cells, and maintaining major components of a PV system. |

#### 4. Teaching and Learning Methods

1. Interactive Lectures
2. Tutorials
3. Self-Learning
4. Experimental Learning

#### Course Schedule

| Number of the Week | Scientific content of the course<br>(Course Topics)                                                                                                                                                                            | Total Weekly Hours | Expected number of the Learning Hours |                |                 |                             |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------|----------------|-----------------|-----------------------------|
|                    |                                                                                                                                                                                                                                |                    | Lecture Hours                         | Tutorial Hours | Practical Hours | Self-learning (Assignments) |
| 1                  | Sunlight energy, energy conversion, solar radiation measurement, principles of solar cell operation, structure, electrical and optical characteristics, and crystalline silicon solar cells and thin film technologies for PV. | 5                  | 2                                     | 1              | 2               | -                           |
| 2                  | Sunlight energy, energy conversion, solar radiation measurement, principles of solar cell operation, structure, electrical and optical                                                                                         | 5                  | 2                                     | 1              | 2               | -                           |



|   |                                                                                                                                                                                                                                                    |   |   |   |   |                       |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|-----------------------|
|   | characteristics, and crystalline silicon solar cells and thin film technologies for PV.                                                                                                                                                            |   |   |   |   |                       |
| 3 | Calibration and testing of PV modules and solar cells, and maintaining major components of a PV system.                                                                                                                                            | 5 | 2 | 1 | 2 | -                     |
| 4 | Calibration and testing of PV modules and solar cells, and maintaining major components of a PV system.                                                                                                                                            | 7 | 2 | 1 | 2 | Assignments 1 (2 Hrs) |
| 5 | Equivalent circuit, Crystalline silicon solar cells, thin film technologies for PV, building integrated PV (BIPV), Energy production by a PV array, Energy balance in stand-alone PV systems                                                       | 6 | 2 | 1 | 2 | Assignments 2 (1 Hr)  |
| 6 | The estimated cost and payback times for the various technologies, the advantages and disadvantages of each type, feed-in tariffs and other ,incentives<br>Standards, calibration and testing of PV modules and solar cells, PV system .monitoring | 5 | 2 | 1 | 2 | -                     |
| 7 | First Mid-Term Exam                                                                                                                                                                                                                                |   |   |   |   |                       |
| 8 | The estimated cost and payback times for the various technologies, the advantages and disadvantages of each type, feed-in tariffs and other ,incentives<br>Standards, calibration and testing of PV modules and solar cells, PV system .monitoring | 7 | 2 | 1 | 2 | Assignments 3 (2 Hr)  |
| 9 | The estimated cost and payback times for the various technologies, the advantages and disadvantages of each                                                                                                                                        | 5 | 2 | 1 | 2 | -                     |



|    |                                                                                                                                                                                                                                                    |   |   |   |   |                         |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|-------------------------|
|    | type, feed-in tariffs and other ,incentives<br>Standards, calibration and testing of PV modules and solar cells, PV system .monitoring                                                                                                             |   |   |   |   |                         |
| 10 | The estimated cost and payback times for the various technologies, the advantages and disadvantages of each type, feed-in tariffs and other ,incentives<br>Standards, calibration and testing of PV modules and solar cells, PV system .monitoring | 7 | 2 | 1 | 2 | Assignments 4<br>(2 Hr) |
| 11 | Sizing of PV grid-connected system                                                                                                                                                                                                                 | 6 | 2 | 1 | 2 | Assignments 5<br>(1 Hr) |
| 12 | Social and environment aspects of PV systems                                                                                                                                                                                                       | 6 | 2 | 1 | 2 | Assignments 6<br>(1 Hr) |
| 13 | Basics of testing and maintaining major components of a PV system                                                                                                                                                                                  | 5 | 2 | 1 | 2 | -                       |
| 14 | Basics of testing and maintaining major components of a PV system                                                                                                                                                                                  | 7 | 2 | 1 | 2 | Assignments 7<br>(2 Hr) |
| 15 | Revision                                                                                                                                                                                                                                           | 5 | 2 | 1 | 2 | -                       |
| 16 | Final Exam                                                                                                                                                                                                                                         |   |   |   |   |                         |

## 5. Methods of students' assessment

| No. | Assessment Methods *  | Assessment Timing<br>(Week Number) | Marks/<br>Scores | Percentage of<br>total course Marks |
|-----|-----------------------|------------------------------------|------------------|-------------------------------------|
| 1   | Mid-term written Exam | 7                                  | 20               | 20%                                 |
| 2   | Final Written Exam    | 16                                 | 40               | 40%                                 |
| 3   | Assignments           | 4,5,8,10,11,12,14                  | 15               | 15%                                 |
| 4   | Quizzes               | 5 & 10                             | 15               | 15%                                 |
| 5   | Final Practical Exam  | 15                                 | 10               | 10%                                 |



## 6. Learning Resources and Supportive Facilities

|                                                                        |                                                      |                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Learning resources<br/>(books, scientific references, etc.) *</b>   | <b>The main (essential) reference for the course</b> | 1) Renewable Energy: Power for a sustainable future, by godfrey boyle oxford university press; 2nd edition, 2020.<br>2) Gilbert, M. M., "Renewable and Efficient Electric Power Systems", John Wiley & Sons, 1st Edition, 2021. |
|                                                                        | <b>Other References</b>                              | JÄGER, Klaus-Dieter, et al. Solar energy: fundamentals, technology and systems. UIT Cambridge, 2016.                                                                                                                            |
|                                                                        | <b>Electronic Sources</b>                            | <a href="http://www.ekb.eg">www.ekb.eg</a>                                                                                                                                                                                      |
|                                                                        | <b>Learning Platforms</b>                            | <a href="https://lms.nub.edu.eg/login/index.php">https://lms.nub.edu.eg/login/index.php</a>                                                                                                                                     |
| <b>Supportive facilities &amp; equipment for teaching and learning</b> | <b>Devices/Instruments</b>                           | Data Show                                                                                                                                                                                                                       |
|                                                                        | <b>Supplies</b>                                      | White Board                                                                                                                                                                                                                     |
|                                                                        | <b>Electronic Programs</b>                           | Homer and PVsyst Software Programs                                                                                                                                                                                              |
|                                                                        | <b>Skill Labs/ Simulators</b>                        | –                                                                                                                                                                                                                               |
|                                                                        | <b>Virtual Labs</b>                                  | –                                                                                                                                                                                                                               |
|                                                                        | <b>Other (to be mentioned)</b>                       | Lecture Hall and Laboratory Usage                                                                                                                                                                                               |

**Dr. Beshoy Abdou Aziz**  
Course Coordinator

**Dr. Mohamed Kourany Saad**  
Program Coordinator