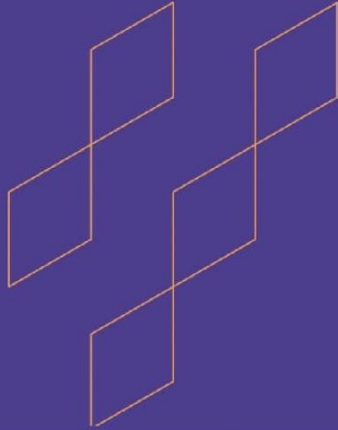




# Course Specification

## (Postgraduate Programs)

|                            |                                          |
|----------------------------|------------------------------------------|
| <b>Course Title:</b>       | Renewable and Sustainable Energy Systems |
| <b>Course Code:</b>        | 2202-519                                 |
| <b>Program:</b>            | Master in Electrical Engineering         |
| <b>Department:</b>         | Electrical Engineering                   |
| <b>College:</b>            | College of Engineering                   |
| <b>Institution:</b>        | King Faisal University                   |
| <b>Version:</b>            | V2                                       |
| <b>Last Revision Date:</b> | 14 April 2025                            |

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## A. General information about the course:

### 1. Course Identification:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                              |                                  |                                                |                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------|------------------------------------------------|--------------------------------|
| <b>1. Credit hours: ( 3 )</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                              |                                  |                                                |                                |
| <b>2. Course type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                              |                                  |                                                |                                |
| A.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <input type="checkbox"/> University          | <input type="checkbox"/> College | <input checked="" type="checkbox"/> Department | <input type="checkbox"/> Track |
| B.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <input checked="" type="checkbox"/> Required |                                  | <input type="checkbox"/> Elective              |                                |
| <b>3. Level/year at which this course is offered: Level 1/1<sup>st</sup> year</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                              |                                  |                                                |                                |
| <b>4. Course General Description:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                              |                                  |                                                |                                |
| The Renewable and Sustainable Energy Systems course provides a graduate level understanding of the conversion principles and technology behind various renewable energy sources. It also examines the issues involved in the integration of various renewable energy sources and their economics for heat, power, and transportation needs. The outlook for each of the sources and systems is discussed.                                                                                                                                                                                                      |                                              |                                  |                                                |                                |
| <b>5. Pre-requirements for this course (if any):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                              |                                  |                                                |                                |
| Graduate Student Standing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                              |                                  |                                                |                                |
| <b>6. Co-requisites for this course (if any):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                              |                                  |                                                |                                |
| None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                              |                                  |                                                |                                |
| <b>7. Course Main Objective(s):</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                              |                                  |                                                |                                |
| <ul style="list-style-type: none"> <li>• Perform the resource assessment of renewable energy sources for electricity generation.</li> <li>• Model the performance of distributed energy sources for grid-connected operation.</li> <li>• Analyze and design off-grid renewable energy systems.</li> <li>• Articulate the technical challenges for each of the renewable sources; and</li> <li>• Discuss economic, technical, and sustainability issues involved in the integration of renewable energy systems.</li> <li>• Perform a system level cost-benefit analysis of renewable energy systems</li> </ul> |                                              |                                  |                                                |                                |

### 2. Teaching Mode: (mark all that apply)

| No | Mode of Instruction   | Contact Hours | Percentage |
|----|-----------------------|---------------|------------|
| 1  | Traditional classroom | 45            | 100%       |





| No | Mode of Instruction                                                                                | Contact Hours | Percentage |
|----|----------------------------------------------------------------------------------------------------|---------------|------------|
| 2  | E-learning                                                                                         |               |            |
| 3  | Hybrid <ul style="list-style-type: none"> <li>Traditional classroom</li> <li>E-learning</li> </ul> |               |            |
| 4  | Distance learning                                                                                  |               |            |

### 3. Contact Hours: (based on the academic semester)

| No | Activity                                             | Contact Hours   |
|----|------------------------------------------------------|-----------------|
| 1. | Lectures                                             | 45              |
| 2. | Assignments                                          | 0               |
| 3. | Library                                              | 0               |
| 4. | Projects/Research Essays/Theses                      | 0               |
| 5. | Others (specify) Introduction to Simulation Software | 6               |
|    | <b>Total</b>                                         | <b>51 Hours</b> |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

| Code | Course Learning Outcomes                                                                                                                        | Code of PLOs aligned with the program | Teaching Strategies | Assessment Methods |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------------|--------------------|
| 1.0  | <b>Knowledge and understanding</b>                                                                                                              |                                       |                     |                    |
| 1.1  | Identify and formulate engineering problems for renewable energy systems, distributed generation systems and distribution/transmission networks | K1                                    | Lectures            | Assignments        |
| 1.2  | Understanding of the conversion principles and technology behind various renewable energy sources                                               | K1                                    | Lectures            | Assignments        |
| 1.3  | Recognize the challenges involved in the integration of various renewable                                                                       | K1                                    | Lectures            | Assignments        |





| Code       | Course Learning Outcomes                                                                                         | Code of PLOs aligned with the program | Teaching Strategies | Assessment Methods                      |
|------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------------|-----------------------------------------|
|            | energy sources and their economics                                                                               |                                       |                     |                                         |
| <b>2.0</b> | <b>Skills</b>                                                                                                    |                                       |                     |                                         |
| 2.1        | Use tools and techniques for conducting research in design and performance of renewable energy sources.          | S1                                    | Research project    | -Assignments<br>-Examination            |
| 2.2        | Prepare written reports related to integration of renewable energy sources projects and make oral presentations. | S1                                    | Research project    | -Assignments<br>-Examination            |
| <b>3.0</b> | <b>Values, autonomy, and responsibility</b>                                                                      |                                       |                     |                                         |
| 3.1        | Use tools and techniques for conducting research in design and performance of renewable energy sources.          | V2                                    | Research project    | -Submitted Report<br>-Oral presentation |
| 3.2        | Prepare written reports related to integration of renewable energy sources projects and make oral presentations. | V2                                    | Research Project    | -Submitted Report<br>-Oral Presentation |

### C. Course Content:

| No | List of Topics                                          | Contact Hours |
|----|---------------------------------------------------------|---------------|
| 1. | Alternate sources of electrical power generation        | 3             |
| 2. | Review of renewable energy sources design and operation | 6             |
| 3. | Modeling of solar energy systems                        | 6             |
| 4. | Modeling of tidal, geothermal, and Hydro power plants   | 6             |
| 5. | Modelling of wind farms                                 | 6             |
| 6. | Sizing energy storage systems                           | 3             |
| 7. | Fuel cell design and evaluation                         | 6             |



|              |                                             |           |
|--------------|---------------------------------------------|-----------|
| 8.           | Design of hybrid systems in the power grid  | 3         |
| 9.           | Cost-benefit analysis at power system level | 6         |
| <b>Total</b> |                                             | <b>45</b> |

## D. Students Assessment Activities:

| No | Assessment Activities *            | Assessment timing (in week no) | Percentage of Total Assessment Score |
|----|------------------------------------|--------------------------------|--------------------------------------|
| 1. | Assignments                        | Weeks 3,5,8,12                 | 15%                                  |
| 2. | Midterm                            | Week 9                         | 25%                                  |
| 3. | Research paper and oral discussion | Week 14                        | 25%                                  |
| 4. | Final Exam                         | Week 15                        | 35%                                  |
| 5. | Total                              |                                | 100%                                 |

\*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

## E. Learning Resources and Facilities:

### 1. References and Learning Resources:

|                                 |                                                                                                            |
|---------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>Essential References</b>     | Alternative Energy Systems and Applications, B. K. Hodge, 2nd Edition, 2017 John Wiley & Sons, Ltd         |
| <b>Supportive References</b>    | Renewable Energy in Power Systems, by David Infield and Leon Freris, Wiley; 2nd edition (February 3, 2020) |
| <b>Electronic Materials</b>     | Handouts                                                                                                   |
| <b>Other Learning Materials</b> | Scientific journal reading, reviewing and analysis                                                         |

### 2. Educational and Research Facilities and Equipment Required:

| Items                                                                                     | Resources                            |
|-------------------------------------------------------------------------------------------|--------------------------------------|
| <b>facilities</b><br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Classroom : 30 seats                 |
| <b>Technology equipment</b><br>(Projector, smart board, software)                         | Data show<br>HOMER<br>ETAP<br>PVSYST |
| <b>Other equipment</b><br>(Depending on the nature of the specialty)                      | Computer Lab                         |

#### F. Assessment of Course Quality:

| Assessment Areas/Issues               | Assessor                         | Assessment Methods                                                                                            |
|---------------------------------------|----------------------------------|---------------------------------------------------------------------------------------------------------------|
| Effectiveness of teaching             | Students                         | Indirect: Online Course Evaluation                                                                            |
| Effectiveness of students' assessment | EE Faculty members<br>Students   | Direct: Course Report Presentation<br>Direct: Assessment using student grades<br>Indirect: Assessment of CLOs |
| Quality of learning resources         | Instructor<br>EE Faculty members | Direct: Course Report                                                                                         |
| Overall course quality                | Course Instructor                | Direct: Course Report                                                                                         |
| Improvement Plans                     | EE Department                    | Direct: Course Report Presentation                                                                            |

**Assessor** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

**Assessment Methods** (Direct, Indirect)

#### G. Specification Approval Data:

| COUNCIL /COMMITTEE | EE DEPARTMENT QUALITY COMMITTEE |
|--------------------|---------------------------------|
| REFERENCE NO.      | MEETING # 10                    |
| DATE               | APRIL 19, 2025                  |