

## Sustainable Engineering and Green Design

### Course general description:

In an era of increasing environmental challenges, sustainable engineering and green design have become critical to creating systems and products that minimize ecological impact while maximizing resource efficiency. This course provides a comprehensive exploration of the principles, tools, and techniques used in eco-friendly design, lifecycle assessment (LCA), and waste reduction strategies. Participants will learn how to integrate sustainability into engineering practices, from conceptualization to end-of-life management, ensuring compliance with global environmental standards and fostering innovation.

### Audience:

This course is designed for:

1. Engineers and designers involved in product development and system design.
2. Environmental consultants and sustainability professionals.
3. Project managers and decision-makers seeking to integrate sustainability into projects.
4. Academics and students in engineering, environmental science, and industrial design fields.

### Course objectives:

By end of the course participants will gain:

1. Understand the principles of sustainable engineering and green design.
2. Learn to conduct lifecycle assessments (LCA) for products and systems.
3. Apply waste reduction strategies and circular economy concepts.
4. Explore advancements in renewable energy, materials, and sustainable technologies.
5. Develop skills in designing eco-friendly systems and products through case studies and practical exercises.
6. Gain awareness of regulatory frameworks and certifications related to sustainability.

### Course duration:

5 days

### Course location:

Cairo-Dubai-Istanbul

### Course contents:

#### **Day 1: Principles of Sustainable Engineering and Green Design**

- Introduction to Sustainable Engineering – Importance, key principles (reduce, reuse, recycle, rethink), and the engineer's role in addressing environmental challenges.
- Green Design Fundamentals – Eco-design principles, biomimicry, energy efficiency, and environmental impact assessment tools.
- Case Study & Pretest – Analyze a sustainable product, assess baseline knowledge, and discuss green design challenges.

#### **Day 2: Lifecycle Assessment (LCA) Methodology**

- Introduction to LCA – Overview of LCA stages, ISO 14040/14044 standards, and decision-making applications.
- Conducting an LCA – Data collection, software tools (SimaPro, GaBi, OpenLCA), and result interpretation.
- Practical Exercise & Quiz – Perform a simplified LCA on a product and analyze its environmental impact.

#### **Day 3: Waste Reduction and Circular Economy**

- Waste Reduction Strategies – Optimizing design, process efficiency, zero-waste initiatives, and industrial symbiosis.
- Circular Economy Concepts – Principles of reuse, refurbishment, recycling, and sustainable business models.
- Case Study & Discussion – Evaluate a company’s circular economy transition and discuss industry challenges.

#### **Day 4: Renewable Energy and Sustainable Materials**

- Renewable Energy Integration – Solar, wind, hydro, and bioenergy; energy-efficient systems; smart grids.
- Sustainable Materials & Technologies – Biodegradable, recyclable materials; green chemistry; nanotechnology.
- Hands-On Simulation – Design a solar-powered system and propose a sustainable material substitution.

#### **Day 5: Regulatory Frameworks, Certifications, and Final Assessment**

- Environmental Regulations & Certifications – REACH, RoHS, ISO 14001, LEED, Cradle to Cradle.
- Future Trends & Career Pathways – Net-zero goals, carbon neutrality, digital twins, and interdisciplinary opportunities.
- Final Assessment & Feedback – Comprehensive test, post-test comparison, and discussion on key takeaways.

#### **Methodology:**

- 50% lectures & concepts
- 10% Videos
- 15% Case studies
- 15% Exercises
- 10% Discussions

**Course code: (TGRL003)**