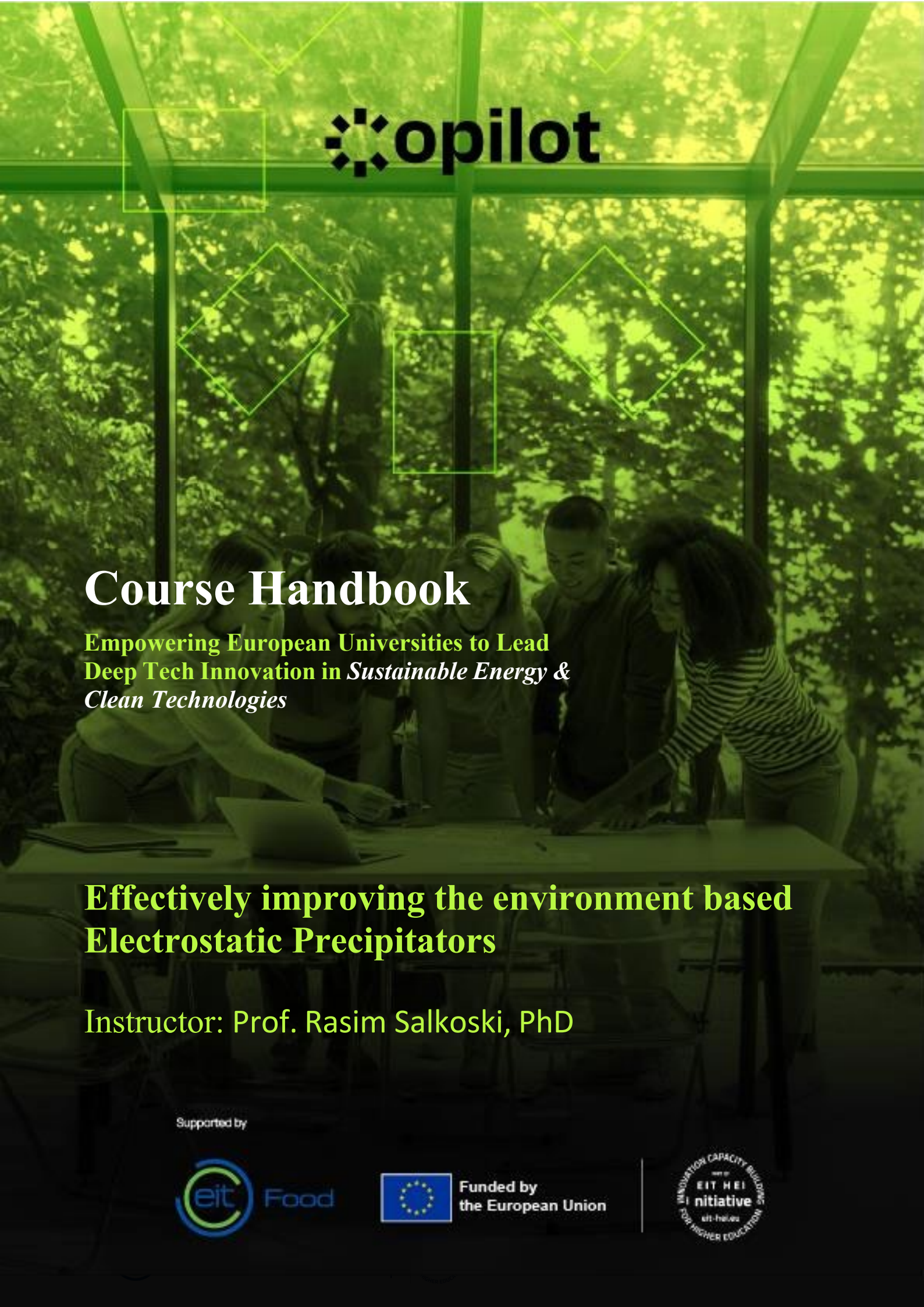


Course Handbook

Empowering European Universities to Lead Deep Tech Innovation in *Sustainable Energy & Clean Technologies*

Effectively improving the environment based Electrostatic Precipitators

Instructor: Prof. Rasim Salkoski, PhD

Supported by

Funded by the European Union

CONTENTS

Course Information 3
Course Summary 3
Learning Outcomes 3
Assessment 4
Mentoring 5
Bibliography 5
Other Important Information 6
Course Timetable 6
Contact Details of Instructor(s) 6

Course Information

Title: ***Effectively improving the environment based Electrostatic Precipitators***

Instructor**:** Prof. Rasim Salkoski, PhD

ECTS credits**:** 2

Course structure: 5 sessions, 2 lectures + 2 tutorials per session

Mode of delivery: o*nline*

Course Summary

This course equips all course participants with the essential knowledge and skills to identify major components of an Electrostatic Precipitator(ESP), types of Electrostatic Precipitators(ESP), how ESP's operate, environmental and economic impact and industrial applications with special emphasis to power plants, cement and steel industries, food industry and chemical industry. Through a combination of theoretical insights and practical applications, participants will learn that ESP's are the backbone of modern automatic pollution control technology. As essential components in various industries where they effectively remove particulate matter from exhaust gases, they will continue to play a vital role in protecting the environment and ensuring compliance with air quality regulations. Guidelines will be provided for improving the performance of the power supply (rectifier unit) of the Electrostatic Precipitator (ESP) from the perspective of the environmental protection process.

Course Participants

The course "Effective Environmental Improvement Based on Electrostatic Precipitators" is designed for a diverse audience of students of environmental science, engineering and related disciplines, researchers, academic and non-academic professionals, industry professionals and ambitious service companies to familiarize themselves with the typical operation and maintenance problems of Electrostatic Precipitators(ESP's).

Learning Outcomes

Upon completion of the course, participants will be able to do the following:

- Identify and describe of the function of the main components of the Electrostatic Precipitator(ESP)
- Describe of the function and principle of operation of the Electrostatic Precipitator(ESP)
- Describe of the distinguish between different types of Electrostatic Precipitators(ESP)
- Describe of the function of the key factors for the performance of the Electrostatic Precipitator(ESP)

- Describe of the function of the key safety measures when working with an Electrostatic Precipitator(ESP).
- Identify and describe of the function of the power supply rectifier unit of the Electrostatic Precipitator(ESP)
- Improving the performance of the ESP's power supply unit from the aspect of environmental protection process.

Assessment

In order for each participant to complete the course successfully and be awarded the corresponding ECTS credits, they must pass the course assessment. The outcome of the assessment can be either Pass or Fail.

Assessment methods

- Project essay (50%): Essay on the function and principle of operation of an Electrostatic Precipitator(ESP) for thermal power plants
- Oral presentation (30%): Describe the guidelines for improving the performance of the high-voltage rectifier unit of the ESP from the aspect of the environmental protection process
- Class participation (20%): Active participation and contribution in discussions on course topics.

The link between learning objectives and assessment criteria can be seen below.

Learning outcomes	Assessment examples
• Identification of the basic components of the ESP for thermal power plants; • Description of the difference between different ESP's; • Different ESP performances for thermal power plants; • ESP model for thermal power plant.	Essay on the function and principle of operation of an ESP for thermal power plants
• Identification of various high voltage power supply units of ESP; • Description of the high-voltage power supply unit of the ESP for a thermal power plant; • Improving the performance of the high-voltage rectifier unit of the ESP for a thermal power plant; • Modeling of the high-voltage rectifier unit for ESP for thermal power plants.	Describe the guidelines for improving the performance of the high-voltage rectifier unit of the ESP from the aspect of the environmental protection process

Mentoring

In the context of the course, participants will have the opportunity to receive one-to-one mentoring in carrying out their assignment/project.

Bibliography

1. Schmoch M., Steiner, D. (2024). *Overview of the Design and Function of Electrostatic Precipitators*. In: Electrostatic Precipitator Handbook. Springer, Wiesbaden.

The publication discusses the architecture of the active part of the electrostatic precipitator (ESP) giving guidance that it consists of several strips formed by grounded plates, collection electrodes (CE). Also the shape of the plates which can be straight or can form tubes, e.g. cylinders or prisms. The particles/gas flows through the free strips between them or through the tubes. Plate ESPs regularly have horizontal flow and separate dry dusts.

2. Chiang, PC., Gao, X. (2022). *Electrostatic Precipitator*. In: Air Pollution Control and Design. Springer, Singapore

The publication provides a global overview of Electrostatic precipitators, also known as ESP, have been widely used for material recovery and particulate removal for over a century since it was perfected by Frederick Cottrell

3. Chakrabarti D., Pritchard R., Kirsten M., Mauritzson C. (2009). *Challenges for Reduction in Emission in Old Electrostatic Precipitators at Lower Cost*. In: Yan K. (eds) Electrostatic Precipitation. Springer, Berlin, Heidelberg.

This paper discusses and compare the emission performance enhancement of two Industrial ESPs plants in Australia. Industrial plants are one of the major users of Electrostatic Precipitators (ESP's) for particulate emission control. These are primarily Cement, Metallurgy, Pulp & Paper and Aluminum industries. The paper generally speaks about the challenges that we face with the old Industrial Precipitators to cope with stringent emission norms in spite of Physical dimensional and plant layout Restrictions.

4. B M., Lemont F., Reess T., Silvestre de Ferron A., Souakri S. (2016). *Electrostatic Precipitator: Technological Development and Applications to Thermal Incineration Processes in CEA* International Journal of Plasma Environmental Science & Technology, Vol.10, No.2, DECEMBER 2016, 157-160.

The paper discusses existing conventional electrostatic precipitators nevertheless need to be adapted before considering introducing this technology into the nuclear environment. These paper summaries the experimental work carried out on an electrostatic precipitator set up in a CEA Marcoule process (The CEA Marcoule process involves a comprehensive range of activities related to the nuclear fuel).

5. Salkoski R., Chorbev I. (2015). *Design optimization of transformer rectifier unit for electrostatic precipitators based on Differential Evolution Algorithms*, ETAI 2015, Ohrid, N.R. Macedonia

In this paper discusses the combinatorial optimization techniques used in the design of the transformer rectifier unit (T/R unit) result in saving of supply electric energy for the electrostatic precipitators. The transformer rectifier unit (T/R unit) for electrostatic precipitators has found application in the iron and steel industry, the paper and pulp industry, the cement industry, coal and oil burning power stations etc. In that regard, special interest is given to the minimization of production and exploitation costs of the T/R unit. The T/R unit contains: High tension single phase transformer, Current limiting reactor, High frequency reactor and High tension Rectifier Bridge. In the paper the combinatorial optimization algorithm based on Differential Evolution is described and

applied to the problem of minimizing the cost of the active parts of all objects which belong to the T/R unit.

6. *https://www.irsweb.it/*

IRS solutions for electrostatic precipitators, simESP: Electrostatic precipitator detailed physical model, ORCHIDEE: Plant performance optimization software, IRS consulting services for ESP sizing and revamping, IRS consulting services: smart ESP control and plant operator training

7. *https ://power.mhi.com/group/es/products/e-precipitator*

Additional resources for learning about practical issues for ESP's

Other Important Information

Course evaluation: Upon successful completion of the course, participants are required to fill in the course evaluation questionnaire.

Certificate: Upon successful completion of the course, participants will be issued a certificate of achievement provided by UIST and EIT Food KIC.

Plagiarism: UIST has explicit rules concerning academic dishonesty, including plagiarism. Course participants are reminded that all work submitted as part of the requirements for any examination (including coursework) of UIST must be expressed in their own words and incorporated in their own ideas and judgements.

Course Timetable

Session	Date and Time	Instructor	Venue
1st	Tuesday 14.04.2026, 15:00 -19:00	Rasim Salkoski	Online
2nd	Friday 17.04.2026, 15:00 -19:00	Rasim Salkoski	Online
3rd	Tuesday 21.04.2026, 15:00 -19:00	Rasim Salkoski	Online
4th	Friday 24.04.2026, 15:00 -19:00	Rasim Salkoski	Online
5th	Tuesday 28.04.2026, 15:00 -19:00	Rasim Salkoski	Online

Contact Details of Instructor

Name	Email	Telephone number
Rasim Salkoski	rasim.salkoski@uist.edu.mk	+389 75837586

opilot

Supported by

Funded by the European Union