Syllabus of CCUME, Academic Year 2025, 1st Semester

Course Name： (Chinese) 大氣電漿技術應用與檢測 (English) Applications and Characterization of Atmospheric-Pressure Plasma Discharges					Course Department	Mechanical Engineering
					Course Code	4465001
Instructor	Lin, Kun-Mo	Credit	3	☐Required Course ■Elective Course	**Target Students**	Senior, Master/Ph.D
Prerequisite(s)：Fundamental Physics, Engineering Mathematics						

Course Description:

Atmospheric pressure plasma discharges have been used extensively in applications such as combustion and pollution control. This course is designed to introduce the importance of plasma discharges in applications and diagnostics applied to characterize discharge properties. To understand discharge behavior, it is essential to conduct both experimental measurements and numerical simulations. The topics introduced in this course include different applications, details of ultraviolet absorption spectroscopy (one of the methods for measuring species density), and a plasma fluid model for understanding discharge fundamentals.

Objectives:

To ensure students understand

1. The importance of plasmas in different applications.
2. The experimental method applied to measure species density.
3. The numerical model used to predict the discharge behavior.

Suggested reading:

Although it is not necessary, but students are encouraged to review

1. Partial differential equations

References	1. A. Grill, “Cold Plasma in Materials Fabrication,” 1st ed., Wiley-IEEE Press, 1994. 2. P. K. Chu, and X. P. Lu, “Low Temperature Plasma Technology-Methods and Applications,” 1st ed., Taylor & Francis Group, 2014.

Course Outline		**Hours**				**Achievable Core Competence of Course**
Topic	**Contents**	**Lecture**	**Demonstration**	**Assignments**	**Other**	
Introduction	1. Plasma fundamentals 2. Plasma classifications	3				D1, D2, D8
Applications	1. Plasma-assisted combustion 2. Pollution control	9		6		D1, D2, D8
Plasma Fluid Model	1. Simulation basics 2. Governing equations 3. Chemistry of air discharges 4. Chemistry of He discharges 5. Virtual probes	15	3			D1, D2, D8

Plasma Diagnostics	1. Measurements of electric properties 2. Optical emission spectroscopy 3. Ultraviolet absorption spectroscopy	6				D1, D2, D8
Case Study	1. He discharge	3		6		D1, D2, D8
Achievable Core Competence of Course		**Achievable Indicators of Core Competence**				
D1	Well established advanced knowledge in mechanical engineering					
D2	Competence in planning and conducting research and development projects in mechanical engineering and related disciplines					
D8	Engagement to lifelong learning					

Notes:

Time	**Location**	**Grade**	Office hour	**Assessment of Teaching quality**
Wed: 09:10-12:00	ME 214(L)	Attendance: 10% Participation: 10% Homework: 35% Midterm exam: 20% Final report: 25%	Tue:10:00-12:00	1.Student Evaluation of Teaching 2 Questionnaire on the Level of Achievement of Core Competence

Week	**Subject & Homework**	**Remarks**
1	Introduction of plasma fundamentals – discharge parameters	
2	Introduction of plasma fundamentals – discharge behavior	
3	Application – Combustion I	
4	Application – Combustion II	
5	Application – Pollution control I	
6	Application – Pollution control II	
7	Diagnostics – UVAS (ozone) I	
8	Simulation – Plasma fluid model I	
9	Simulation – Plasma fluid model II	
10	Simulation – Plasma fluid model III – Poisson equation	
11	Simulation – Chemistry of helium discharges	

12	Simulation – Chemistry of air discharges	
13	Simulation – Work with the program of plasma fluid model	
14	Case study – Work with virtual probes I - Parameters	
15	Case study – Work with virtual probes II (Output format)	
16	Case study – Discharge analysis	
17	Final report (Case study)	
Others:		