MNE6139: COMBUSTION SCIENCE

Effective Term
Summer Term 2026

Part I Course Overview

Course Title
Combustion Science

Subject Code
MNE - Mechanical Engineering
Course Number
6139

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Additional Information
Nil

Part II Course Details

Abstract

The purpose of this course is to provide fundamental scientific aspects of modern combustion, to develop a sound understanding of relations among fuels, combustion processes, and pollutant emissions, and to develop knowledge for the evaluation of chemical kinetics, fluid dynamics, heat transfer, and mass transfer of a combustion process.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the combustion process between fuels and oxygen, and the different types of flames.			x	
2	Apply Thermodynamics to solve the energy conversion of a combustion process.			x	
3	Apply Chemical Kinetics of Combustion to evaluate the chemical reaction of a combustion process.			x	
4	Evaluate the air pollutants formed and emitted during a combustion process.			x	
5	Understand the most current trend in combustion science with the main goal of protecting the environment.				x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	This includes a combination of lectures and tutorial classes on combustion accompanied by in-class problem solving sessions.	1, 2, 3	6 hours/week

Additional Information for LTAs

N/A

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Test and Assignments	1, 2, 3	40	-	No

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

3

Minimum Continuous Assessment Passing Requirement (%)

40

Minimum Examination Passing Requirement (%)

40

Assessment Rubrics (AR)

Assessment Task

Test and Assignments

Criterion

Describe the underlying physics for combustion and apply them to solve problems with given principles.

Excellent

A+, A, A-

Good

B+, B, B-

Fair

C+, C, C-

Marginal

D

Failure

F

Assessment Task

Examination

Criterion

Demonstrate an understanding of the fundamental combustion behavior of various fuels and solve problems relating to the design and behavior of combustion devices.

Excellent

A+, A, A-

Good

B+, B, B-

Fair

C+, C, C-

Marginal

D

Failure

F

Part III Other Information

Keyword Syllabus

Fundamentals of Combustion Science - nature of combustion; premixed and diffusion flames; laminar and turbulent flames; fuel-lean, stoichiometric and fuel-rich combustion; flame stability and flammable limits.

Fuels and Combustion - gaseous, liquid, and solid fuels; fuel properties; air pollutants formed during combustion process; alternative fuels.

Thermodynamics of Combustion - combustion stoichiometry; chemical equilibrium and equations; Laws of Thermodynamics applying to the combustion process; enthalpy of combustion; Adiabatic flame temperature.

Chemical Kinetics of Combustion - elementary reactions; chain and global reactions; nitrogen oxide kinetics; soot kinetics; dissociation and equilibrium constants.

Combustion-led Air Pollution - carbon oxides and hydrocarbons; sulfur oxides; nitrogen oxides; particulates and soot.

Current Trend in Combustion for Environmental Protection - sulfur-free liquid fuels; low-NOX combustion; bio-fuels; hydrogen; hydrocarbon gaseous fuels enriched with hydrogen.

Reading List

Compulsory Readings

	Title
1	Combustion Physics, Chung K. Law, Cambridge Press

Additional Readings

	Title
1	Combustion Theory, F. A. Williams, Westview Press