Subject Description Form

Subject Code	ME44003
Subject Title	Combustion and Pollution Control
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: ME34002 Engineering Thermodynamics
Objectives	To provide students with the fundamental knowledge of combustion phenomena, and formation and control of combustion-generated air pollutants.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Apply the fundamental knowledge of thermodynamics and chemical kinetics of combustion. b. Apply the general principles of combustion of fuels. c. Understand the formation mechanisms of combustion-generated air pollutants, and fuel emissions. d. Understand and determine appropriate methods for air pollution measurement and control. e. Determine the air pollutant concentration and dispersion from source(s).
Subject Synopsis/ Indicative Syllabus	***Thermodynamics and Chemical Kinetics of Combustion*** **-** Application of First Law of Thermodynamics. Reactant and product gaseous mixtures. Enthalpy of combustion. Adiabatic flame temperatures. Chemical and partial equilibrium. Global versus elementary reaction rates. Chemical time scales. Preignition kinetics. Global and quasi-global mechanisms. Nitrogen oxide kinetics. ***Combustion of Gaseous and Vaporised Fuels*** **-** Laminar and turbulent premixed flames. Diffusion flames. Mechanisms of flame stabilisation. Explosion limits. Mechanisms of quenching, flammability and ignition. ***Combustion of Liquid Fuels*** **-** Spray formation. Size distribution. Fuel injectors. Spray dynamics. Vaporisation of single droplet. ***Air Pollutants and Their Formation*** **-** Formation of carbon monoxide, nitrogen oxides, unburnt hydrocarbon, soot and particulates. Measurement techniques and quantification of air pollutants. ***Fuels and Emissions*** **-** Gasoline and diesel fuels. LPG, natural gas and biodiesel as alternative fuels. Oxygenated fuels. Effect of sulphur contents on diesel emissions. ***Aftertreatment for Motor Vehicle and Power Plant Emissions*** **-** Two and three way catalysts. Cyclones, precipitators, filters and traps, evaluation of capturing efficiency. Scrubbers for flue gas desulphurisation. NOx reduction. Advanced aftertreatment devices/systems.

<table>
<tr><td></td><td>Introduction to Air Pollutant Dispersion - Chimneys, inversions and the atmosphere. Air pollutant concentration and dispersion from motor vehicles and chimneys. Street canyon effect.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Lectures are used to deliver the fundamental knowledge in relation to combustion and pollution control (outcomes a to e).

Tutorials will be conducted to facilitate discussions of typical examples and coursework assignments (outcomes a to e).

<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="5">Outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td></tr>
<tr><td>1. Lecture</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Assignment/Tutorial</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
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<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="5">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td></tr>
<tr><td>1. Assignment</td><td>30%</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Test</td><td>20%</td><td>√</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3. Examination</td><td>50%</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="5"></td></tr>
</table>

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:
0.50 × End of Subject Examination + 0.50 × Continuous Assessment

1. The continuous assessment will comprise two components: assignments (30%) and tests (20%). The assignments are aimed at evaluating the progress of students study, assisting them in fulfilling the respective subject learning outcomes, and enhancing the integration of their knowledge learnt. The mid-term test(s) covers the first half of the subject material and provides useful feedback to both the lecturer and students on the learnt topics.

2. The examination (50%) will be used to assess the knowledge acquired by the students for understanding and analyzing the problems critically and independently; as well as to determine the degree of achieving the intended subject learning outcomes.</td></tr>
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Student Study Effort Expected	Class contact:	
	▪ Lecture	33 Hrs.
	▪ Tutorial	6 Hrs.
	Other student study effort:	
	▪ Self-study/coursework	67 Hrs.
	Total student study effort	106 Hrs.
Reading List and References	1. G.L. Borman and K.W. Ragland, Combustion Engineering, McGraw-Hill, latest edition. 2. R.J. Heinsohn and R.L. Kabel, Sources and Control of Air Pollution, Prentice Hall, latest edition. 3. N.D. Nevers, Air Pollution Control Engineering, McGraw-Hill, latest edition. 4. S.R. Turns, An Introduction to Combustion- Concepts and Applications, McGraw-Hill, latest edition.	

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