Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME556</td></tr>
<tr><td>Subject Title</td><td>Advanced Combustion Systems</td></tr>
<tr><td>Credit Value</td><td>3</td></tr>
<tr><td>Level</td><td>5</td></tr>
<tr><td>Pre-requisite/
Co-requisite/
Exclusion</td><td>Students should have basic knowledge in Thermofluids.

Exclusion: ME541 Combustion Systems and Air Pollution Control</td></tr>
<tr><td>Objectives</td><td>To provide knowledge about the constructions and operation principles, as well as the techniques for performance evaluation of the domestic and industrial combustion systems, which are commonly used in Hong Kong and the surrounding regions; to provide knowledge about the flame and combustion characteristics, and the emissions associated with these combustion systems; to provide knowledge about the thermal modelling techniques of industrial furnace, the design method of industrial chimney and the techniques to predict the dispersion from chimney.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
a. possess state-of-the-art knowledge and skills and be able to contribute to their professional competence in the area of combustion systems (including combustion, heat transfer and emissions);
b. think holistically and critically in solving complex problems and situations pertaining to their professional practice;
c. have recognition of the need for, and an ability to engage in life-long learning;
d. increase their awareness of the local and global environmental issues, existing regulation and policies, as well as the state-of-the-art technologies.</td></tr>
<tr><td>Subject Synopsis/
Indicative Syllabus</td><td>Flame: Premixed and diffusion flames; flame structures and characteristics; effect of fuel types; laminar and turbulent flames; effects of equivalence ratio and Reynolds number; flame stability; effect of combustion on emissions.

Domestic Gas-fired Appliances: Applications; flame and fuel types; design criteria of burner/appliance; heating efficiency assessment; emissions and safety.

Industrial Furnaces: Gas-fired, oil-fired and coal-fired industrial furnaces; burning of gaseous, liquid and solid fuels in furnaces; burners and atomizers; stoker-fired and pulverized-fired furnaces; types of emissions and their control; measurement and analysis of flue gases; handling equipment; selection of combustion equipment.

Thermal Modeling of Furnaces: Heat transfer mechanisms in furnaces; forced convection and gaseous radiation in furnaces; Hottel's zonal method; single gas zone and plug-flow regions; energy balance in furnaces; modeling of combustion products for gaseous radiation calculations.

Chimneys and Flues: Function and operation problems of chimney; design criteria; chimney sizing and thermal insulation; construction and linings; modeling of dispersion of emissions from chimney.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for advanced combustion systems.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="4">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>1. Lecture</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Tutorial</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>3. Homework assignment</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>4. Case study report and presentation</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
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Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Homework assignment	20%	√	√	√	√
2. Test	20%	√	√		√
3. Case study report and presentation	10%	√	√	√	√
4. Examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

$0.50 \times$ End of Subject Examination + $0.50 \times$ Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and case study report & presentation. They are aimed at evaluating the progress of students study, assisting them in self-monitoring of fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learnt.

The examination is 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 subject learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lecture	24 Hrs.
▪ Tutorial/Case study/Laboratory	15 Hrs.
Other student study effort:	
▪ Self Study	45 Hrs.
▪ Case study report preparation and presentation	21 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Borman G. L. and Ragland K. W., *Combustion Engineering*, McGraw-Hill, latest edition.
2. Turns S. R., *An Introduction to Combustion: Concepts and Applications*, McGraw-Hill, latest edition.
3. CIBSE, *Combustion Systems*, CIBSE Guide, Section B13, latest edition.
4. Rogers G. and Mayhew Y., *Engineering Thermodynamics* – Work and Heat Transfer, 4th edition, Longman, latest edition.
5. Modest M. F., *Radiative Heat Transfer*, McGraw-Hill, latest edition.