SUBJECT DESCRIPTION FORMS

Core / Compulsory Subjects

for

MSc in Mechanical Engineering

Subjects Code	Subject Title
ME534	Engineering Acoustics
ME536	Vibration and Structure-borne Noise
ME548	Computer Aided Product Analysis
ME552	Integrated Engineering Design
ME556	Advanced Combustion Systems
ME558	Advanced Materials and Structural Design
ME559	Advanced Environmental and Transportation Noise Control
ME566	Industrial and Environmental Measurement Technology
ME567	Advanced Control Technology
ME569	Thermal System Design and Management
ME570	Advanced Product Mechatronics
ME571	Corrosion Control
ME572	Design for Sustainable Development
ME573	Project on Product Design and Management
ME574	Product Noise Control
ME576	Turbulent Flows and Aerodynamics
ME577	Advanced Aircraft Structures
ME578	Aircraft Design
ME579	Aircraft Noise and Aeroacoustics
ME5201	Hydrogen and Fuel Cells
ME5202	Solar and Wind Engineering
ME5203	Green Combustion
ME5204	Batteries and Capacitors[#]
ME5205	Advanced Energy Storage Technologies
ME5206	Advanced Materials for Clean Energy
ME5207	Electrochemical Energy Conversion Materials and Devices*
ME5510	Thermal Engineering*
ME5610	Air Pollution Engineering*

* Subjects retitled effective from Semester 2 of 2023-24:

1) From ME557 CFD and Thermofluid System Design to ME5510 Thermal Engineering;
2) From ME564 Principles and Design of Air Pollution Control Devices to ME5610 Air Pollution Engineering; and
3) From ME5204 Batteries and Capacitors to ME5207 Electrochemical Energy Conversion Materials and Devices.

[#] Last offer in Semester 1 of 2023-24.

Subject Description Form

Subject Code	ME534
Subject Title	Engineering Acoustics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Dynamics and Thermofluids.
Objectives	To provide the ingredients for students to acquire a sound background in modern acoustics and control of noise.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of physical characteristics of sound, noise radiation mechanism and phenomena of sound propagation; b. apply their knowledge, skills and hand-on experience to measure and analyse the content of sound and design the noise control system; c. extend their knowledge of noise radiation mechanism and noise control principles to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Fundamentals of Acoustics:*** Physical characteristics and acoustic phenomena; noise effect on human beings; noise pollution; human ear; subjective response to noise; wave propagation in media; wave speed, energy and intensity; power and radiation from sources; modeling of wave phenomena; Euler's equation of motion; wave equation and Helmholtz equation. ***Wave Propagation with the Presence of Boundaries:*** Reflection at rigid and impedance boundaries; transmission through interfaces; reactive silencers; wave reflection inside enclosures and acoustic modes. ***Noise Analysis:*** Quantitative measures of sound; frequency content of sounds; acoustic scales; data acquisition and acoustic measurement; digital sampling; signal processing; frequency analysis. ***Noise Sources:*** Flow-induced noises; Von Karman vortices; turbulence noise; jet noise; structural acoustics and vibrations; acoustic structural coupling; elementary sound radiators; and sound source. ***Noise Control:*** Noise attenuation; active noise cancellation; abatement of sound propagation; estimation of barrier insertion loss; acoustical properties of sound absorbing materials and measurement; damping and absorption; viscoelastic damping treatment; impedance of wall structures; calculation of noise level inside a room; transmission and acoustic isolation.

Teaching/Learning Methodology

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 engineering acoustics.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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 or laboratory	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

Textbooks:

1. Hansen C. H. and Snyder S. D., *Active Control of Noise and Vibration*, Spon, latest eidtion.
2. Pierce A. D., *Acoustics*, Acoustic Society of America, latest edition.

	3. Kleppe J. A., *Engineering Application of Acoustics*, Artech House, latest edition. 4. Everest F. A., *The Master Handbook of Acoustics*, Tab Books Inc., latest edition. 5. Bies D. A. and Hansen C. H., *Engineering Noise Control*, Spon, latest edition. 6. Norton M. P., Fundamentals of *Noise and Vibration Analysis for Engineers*, Cambridge University Press, latest edition. 7. Kinsler L. E. et al, *Fundamentals of acoustics*, Wiley, latest edition. Journals: • The Journal of the Acoustical Society of America, Acoustical Society of America. • Journal of Sound and Vibration, Academic Press. • Acustica united with Acta Acustica, S. Hirzel Verlag. • Applied Acoustics, Elsevier Applied Science.

Subject Description Form

Subject Code	ME536
Subject Title	Vibrations and Structure-borne Noise
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Dynamics. Exclusion: ME6101 Advanced Theory and Methods in Vibration Analysis
Objectives	To provide the students an in-depth study in vibration analysis and measurement, and to equip the students with the ability for treating the general vibration problems related to noise abatement at source.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of the noise radiation and vibration mechanism, the relation between noise and vibration and vibration control; b. apply their knowledge, skills and hand-on experience to measure and analyse the content of vibration and design the vibration control system; c. extend their knowledge of the analysis of structural vibration and sound radiation to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Noise Pollution Control at Source:*** Relation between vibration and noise vibration as noise sources; classification of analysis of machinery vibrations. ***Vibration Control:*** Sources of vibration; vibration basics; vibration analysis of continuous structures; vibration isolation and absorption; passive and active vibration control. ***Experimental Assessment of Vibrations:*** Basic measurement system; signal processing; modal parameter identification; time-domain and frequency-domain vibration analysis. ***Noise Generated by Vibrating Structures and Control:*** Elementary noise radiators; noise radiation by machine; noise source identification; sound intensity measurement; identification of noise source; noise radiation and transmission; design principles for noise reduction. ***Typical Laboratory Experiments:*** • Structural modal testing • Vibration control • Measurement of sound intensity

Teaching/Learning Methodology

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 vibrations and structure-borne noise.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	√

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 student 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	42 Hrs.
▪ Case study report preparation and presentation	24 Hrs.
Total student study effort	105 Hrs.

Reading List and References	1. Rao S. S., *Mechanical Vibrations*, Third Edition, Addison-Wesley, latest edition. 2. Thomson W. T, *Theory of Vibration with Applications*, Prentice Hall, latest edition. 3. Dimarogonas A., *Vibration for Engineers, Second Edition*, Prentice-Hall, latest edition. 4. Ewins D.J., *Modal Testing: Theory and Practice*, Research Studies Press Ltd., John Wiley, latest edition. 5. Barron R., *Engineering Condition Monitoring*: Practice, Methods and Applications, Addison Wesley Longman, latest edition. 6. Lyon R. H., *Machinery Noise and Diagnostics*, Butterworths, latest edition. 7. Junger M. C. and Feit D., Sound, Structures and Their Interaction, ASA, latest edition.

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Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME548</td></tr>
<tr><td>Subject Title</td><td>Computer Aided Product Analysis</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 Mechanical Engineering; Building Service Engineering; Civil & Structural Engineering; Manufacturing Engineering; Product Design & Engineering.</td></tr>
<tr><td>Objectives</td><td>To provide students with good understanding of the CAD and CAE technologies. The subject covers computer aided analysis, integration of CAD and CAE, and virtual engineering.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
a. possess knowledge in the area of principle and formulations of finite element method, computer aided design and engineering;
b. analyze static and dynamic stress and strain behaviors of structures and products using CAD and CAE techniques;
c. apply their knowledge and skills to design and develop new products; and
d. have recognition of the need for, and an ability to engage in life-long learning.</td></tr>
<tr><td>Subject Synopsis/
Indicative Syllabus</td><td>Geometric Modeling Systems: Wireframe modeling systems; surface modeling systems; solid modeling systems.
Computer Aided Analysis: Introduction to finite element analysis; finite element software; automatic mesh generation; node connection approach; topology decomposition approach; geometry decomposition approaches; grid-based approach; mapped element approach; improvement of mesh quality; case study.
Finite Element Models of Aircraft Structure: Truss elements; Beam elements; Plate elements; and Shell elements.
Structural Optimization: Sizing optimization; shape optimization; topology optimization; case study.
Virtual Engineering: Definition of virtual engineering; components of virtual engineering; virtual design; digital simulation; virtual prototyping; product lifecycle management.</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 computer aided analysis.
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>
</table>
</td></tr>
</table>

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	25%	√	√	√	√
2. Test	10%	√	√	√	√
3. Project report and presentation	25%	√	√	√	√
4. Examination	40%	√	√	√	√
Total	100%				

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

Overall Assessment:

$0.40 \times$ End of Subject Examination + $0.60 \times$ Continuous Assessment

The continuous assessment consists of three components: homework assignments, test, and project 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	42 Hrs.
▪ Case study report preparation and presentation	24 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Lee K., *Principles of CAD/CAM/CAE Systems*, Addison Wesley, latest edition.
2. Law A. M. and Kelton D. W., *Simulation Modeling and Analysis*, McGraw-Hill, latest edition.
3. Przemieniecki, J. S., Finite Element Structural Analysis, New Concepts, AIAA, latest edition.
4. Donaldson, B. K., Analysis of Aircraft Structures, An Introduction, Cambridge University Press. Latest edition.

Subject Description Form

Subject Code	ME552
Subject Title	Integrated Engineering Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have a good foundation in mechanical sciences.
Objectives	To provide the students with practical experiences in the consecutive stages in design, analysis and development of a new product; to introduce various important considerations in product design and development, and their integration with critical engineering analysis in producing a new product; to introduce project management techniques in producing a new product.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of engineering design and product development process; b. be able to apply their knowledge and contribute to professional competence, including ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability; c. work as an effect team member and have the readiness in assuming a leadership role in a design project; d. think holistically, critically, strategically and creatively in dealing with complex problems and situations pertinent to a design project. e. have a good mastery of critical and creative thinking skills and generate practical and innovative solutions to novel problems; and f. have an ability to recognize the need and engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Conceptual Product Design:*** Customer needs and market situation; technical and business concerns; environmental issues; cultural and social issues; aesthetic and semantic issues; establish product function; visualization skills and CAD. ***Engineering Analysis of Design:*** Benchmarking and establishing engineering specifications of the product; design concept selection; product embodiment: design refining and system modeling; analytical and numerical model solutions; design for manufacture and assembly; CAE and optimization. ***Product Development Techniques:*** Goals of prototyping; types and uses of prototypes; rapid prototyping techniques; physical models and experimentation.

Teaching/Learning Methodology

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 integrated engineering design.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes					
	a	b	c	d	e	f
1. Lecture	√	√	√	√	√	√
2. Tutorial	√	√	√	√	√	√
3. Homework assignment	√	√	√	√	√	√
4. Case study report and presentation	√	√	√	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed					
		a	b	c	d	e	f
1. Homework assignment	20%	√	√	√	√	√	√
2. Test	20%	√	√		√	√	√
3. Case study report and presentation	20%	√	√	√	√	√	√
4. Examination	40%	√	√	√	√	√	√
Total	100%						

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

Overall Assessment:

$0.40 \times$ End of Subject Examination + $0.60 \times$ 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. Pahl G. and Beitz W., *Engineering Design*, Springer-Verlag, latest edition. 2. Ulrich K. and Eppinger S., *Product Design and Development*, McGraw-Hill, latest edition. 3. Otto K. and Wood K., Product Design: *Techniques in Reverse Engineering and New Product Development*, Prentice Hall, latest edition. 4. Clausing D., *Quality Function Deployment*, MIT Press, latest edition. 5. Crawford C. M. and Di Benedetto C.A., *New Product Management*, McGraw-Hill, latest edition. 6. Cooper R. G., Winning at *New Products: Accelerating the Process from Idea to Launch*, Perseus Books, latest edition. 7. Buchanan R. et al., *The Idea of Design*, MIT Press, latest edition. 8. Adams J. L., *Conceptual Blockbusting: a Guide to Better Ideas*, Addison-Wesley, latest edition.

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Subject Description Form

Subject Code	ME556
Subject Title	Advanced Combustion Systems
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids. Exclusion: ME541 Combustion Systems and Air Pollution Control
Objectives	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.
Intended Learning Outcomes	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.
Subject Synopsis/ Indicative Syllabus	***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.

Teaching/Learning Methodology

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.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	√

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.

Subject Description Form

Subject Code	ME558
Subject Title	Advanced Materials and Structural Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Mathematics, Engineering Materials, and Solid Mechanics. Exclusion: ME550 Materials and Smart Structural Design
Objectives	To provide students with knowledge of the mechanical behaviour, manufacturing process and utilizations of advanced composite materials, smart materials and structures, and nano-materials for product design and development with a special emphasize on aircraft applications.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand the mechanics of advanced composite materials, especially the mechanics of a lamina and laminates, including failure mechanisms; b. possess the state-of-the-art knowledge on smart materials and smart structure design; c. recognize the importance of nano-materials in advanced technology; and d. understand the application of advanced composites, smart materials, smart structures, and nano-materials in aircraft design.
Subject Synopsis/ Indicative Syllabus	***Advanced Composite Materials:*** Composite constituents; principles of fibre-reinforced composites; mechanics of a lamina; mechanics of laminates, tooling and manufacturing processes; failure criteria for composites; aircraft applications and related design issues. ***Piezoelectric Materials:*** The fundamental mechanisms of piezoelectric materials and major applications, Curie temperature, concept of piezoelectric moduli and applications of these moduli in design of sensors and actuators, smart structure design issues. ***Shape Memory Alloys (SMA):*** Phenomena & mechanisms of temperature controlled shape memory effect, critical temperatures, stress effect on critical temperatures, mechanical properties of SMA at different phases and temperatures, shape memory and superelasticity, modeling of the effects of temperature and stress, special design considerations at joints, continuum vs. discrete applications of SMA, major impediments to applications of SMA. ***Nanomaterials:*** Nano-materials for product design; mechanical and thermal properties of nano-composite materials. ***Smart Structures:*** Introduction to smart structures; fibre-optic sensors; integrated sensing, controlling and actuating techniques. Selected applications of smart structures in aircraft design. ***Laboratory Works:*** • Mechanical properties of shape memory alloys. • Strain measurement of composite structures using embedded fibre-optic sensors.
Teaching/Learning Methodology	1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, mini-project or case study and examination. 2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for advanced materials and structural design. 3. Technical/practical examples and problems are raised and discussed in class/tutorial

sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√		√
4. Mini-project/Case study report and presentation		√	√	√

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	15%	√			
3. Mini-project/Case study report and presentation	15%		√	√	√
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, mini-project or 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	42 Hrs.
▪ Mini-project/Case study report preparation and presentation	24 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. Alan Baker, Stuart Dutton and Donald Kelly, *Composite Materials for Aircraft Structures,* AIAA, latest edition.
2. Ronald F. Gibson, *Principles of Composite Material Mechanics*, McGRAL-HILL, latest edition.
3. Srinivasan A. V. and McFarland D. M., *Smart Structures*, Cambridge University Press, latest edition.
4. Banks H. T., Smith R. C. and Wang Y., *Smart Material Structures*, John Wiley & Sons, latest edition.
5. Nanostructured Materials - Processing, Properties, and Applications, edited by Carl C. Koch, William Andrew Publishing, latest edition.

Subject Description Form

Subject Code	ME559
Subject Title	Advanced Environmental and Transportation Noise Control
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids and Noise. Some working experience in industry or environmental sectors is desirable. Exclusion: ME535 Industrial and Transportation Noise Control
Objectives	To provide students with knowledge of practical and systematic approach to control noise due to environmental and transportation noise sources.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of physical parameters of sound in transportation and the assessment method; b. apply their knowledge, skills and hand-on experience to measure, calculate and assess the noise level in transportation and keeping aware of the environmental issues, existing regulation and policies concerning noise control; c. extend their knowledge of sound prediction and noise assessment to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Road Traffic Noise:*** Traffic noise indices; calculation of road traffic noise (CRTN) – prediction procedures; the measurement of road traffic noise; the standard drive past test; assessment of noise and vibration impacts due to road traffic. ***Control of Vehicle Noise:*** Identification of noise sources; strategies for controlling vehicle noise; porous pavement for reducing tyre noise; acoustical performance of traffic noise barriers; absorptive barriers; in-situ determination of the acoustical performance of roadside barriers. ***Aircraft Noise:*** Aircraft noise indices; noise certification; aircraft noise sources; the integrated noise model (INM) for aircraft noise prediction; Nordic guidelines for calculation of air traffic noise. ***Rail Transport Noise:*** Railway noise indices; sources of train noise; prediction of train noise – calculation of rail noise (CRN); strategies of controlling rail noise; vibration from railways and its control; measurement techniques.

Teaching/Learning Methodology

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 environmental and transportation noise control.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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	20%	√	√	√	
4. Examination	40%	√	√	√	√
Total	100%				

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

Overall Assessment:

$0.40 \times$ End of Subject Examination + $0.60 \times$ 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	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. Bies D. A. and Hansen C. H., *Engineering Noise Control – Theory and Practice,* E&FN Spon, latest edition. 2. Bell, L. H. *Industrial Noise Control – Fundamentals and Applications*, Marcel Dekker Inc., latest edition. 3. Institute of Acoustics, *Diploma in Acoustics and Noise Control – Tutored Distance Learning Programme, Transportation Noise Unit 1 and Unit 2*. 4. Nelson P. M. (Ed.), *Transportation noise Reference Book*, Butterworths, latest edition.	

July 2023

Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME566</td></tr>
<tr><td>Subject Title</td><td>Industrial and Environmental Measurement Technology</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 Mechanical Engineering; Building Services; Civil & Structural Engineering, Manufacture Engineering. Some working experience in industries is desirable.</td></tr>
<tr><td>Objectives</td><td>To provide students with knowledge of advanced measurement technology and applications in industry.</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 in the area of random data analysis, various measurement techniques, including flow, temperature / heat, force, etc;
b. apply their knowledge, skills and hand-on experience, gained from the subject, to the measurement of flow systems and data analysis;
c. extend their knowledge of mechanical engineering to different situations of engineering context and professional practice; and
d. have recognition of the need for, and an ability to engage in life-long learning.</td></tr>
<tr><td>Subject Synopsis/
Indicative Syllabus</td><td>Random Signal Analysis: Probability density function, time-average, variance, skewness and kurtosis of signals; auto-correlation and cross-correlation functions; power spectral density function of a signal; spectral phase and coherence between two random signals; ensemble averaging technique.
Flow Measurement: Thermal anemometers; laser Doppler velocimetry; particle imaging velocimetry; flow visualization techniques.
Temperature and Heat Measurements: Fibre-optic grating sensors; constant current anemometer and thermocouples; surface temperature sensing with thermochromic liquid crystals and laser interferometry.
Vibration Measurement: Vibration measurement system; fibre-optic Bragg grating sensors, transducers, piezoelectric accelerometers, force transducers, laser vibrometers, strain gauge, electromechanical shakers and hammers.</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 industrial and environmental measurement technology.
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>
</table>
</td></tr>
</table>

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	20%	√	√	√	
4. Examination	40%	√	√	√	√
Total	100%				

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

Overall Assessment:

$0.40 \times$ End of Subject Examination + $0.60 \times$ 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. Goldstein R. J., *Fluid Mechanics Measurements*, Taylor & Francis, latest edition.
2. Beckwith, T. G., Marangoni R. D. and Lienhard J. H., *Mechanical Measurements,* Addison-Wesley Publishing Company, latest edition.
3. Bendat J. S. and Piersol A. G., *Engineering Applications of Correlation and Spectral Analysis*, John Wiley & Sons, Inc. latest edition.

Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME567</td></tr>
<tr><td>Subject Title</td><td>Advanced Control Technology</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 System Dynamics and Control, Industrial Automation, and Mechatronics. Some working experience in Control and Automation is desirable.</td></tr>
<tr><td>Objectives</td><td>To provide students with a good understanding of advanced control technology and its applications in mechanical engineering.</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 in the area of advanced control technology and its application to different mechanical systems;
b. apply their knowledge, skills and hand-on experience to design, develop, manufacture, and analyze mechanical systems with advanced control features or functions for desired needs;
c. extend their knowledge of advanced control technology and its application to different situations of engineering context and professional practice; and
d. have recognition of the need for, and an ability to engage in life-long learning.</td></tr>
<tr><td>Subject Synopsis/
Indicative Syllabus</td><td>Analog Control: Controller design using state-space methods; causality of feedback systems; controllability and observability of linear systems.
Optimal Control: Motivation of optimal feedback controller design; linear quadratic optimal control; elementary theory of nonlinear feedback control; feedback linearization control.
Digital Control: Introductory digital control; sampled-data systems; anti-alias filters; sample rate selection; discrete-time systems and z-transform; digital controller design.
Microcomputer Implementation: Microcomputer implementation of controllers; introduction to system identification; self-tuning control; control of twin-rotor system; control of an inverted pendulum.</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 control technology.
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>
</table>
</td></tr>
</table>

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	30%	√	√	√	√
2. Case study/Lab report and presentation	10%	√	√	√	
3. Examination	60%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.60 × End of Subject Examination + 0.40 × 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/Laboratary	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. Bryson A. E., *Applied Linear Optimal Control: Examples and Algorithms,* New York, N.Y.: Cambridge University Press, latest edition.
2. Dorsey, John. *Continuous and Discrete Control Systems: Modeling, Identification, Design, and Implementation*, Boston: McGraw-Hill, latest edition.
3. Kisačanin, Branislav, *Linear Control Systems: with Solved Problems and MATLAB Examples,* New York : Kluwer Academic/Plenum Publishers, latest edition.

Subject Description Form

Subject Code	ME569
Subject Title	Thermal System Design and Management
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids.
Objectives	To provide students with knowledge of advanced thermal technology; and make students have the ability to solve practical problems in industry.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of heat transfer and thermal sciences, be able to apply their knowledge and skills in designing and developing products or engineering systems; b. think critically and holistically in dealing with real thermal and energy problems, and generate practical solutions; and c. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Review of Heat Transfer:*** Steady and unsteady conduction; forced and natural convection, and radiation. ***Heat Pipe:*** Theory of heat pipe; types of the heat pipe; heat pipe design and manufacturing; heat pipe applications. ***Cooling of Electronic Equipment:*** Cooling load of electronic equipment; thermal environment; conduction cooling, convection cooling and liquid cooling. ***Heating and Cooling of Buildings:*** Thermal comfort; design conditions for heating and cooling; heat gain from people; lights and appliances; solar heat gain; infiltration heat load and weatherizing. ***Refrigeration and Freezing of Foods:*** Control of microorganisms in foods; thermal properties of foods; refrigeration of fruits, vegetables and cut flowers; refrigeration of meats, poultry and fish; refrigeration of eggs, milk and bakery products; refrigeration load of cold storage rooms; transportation of refrigerated foods. ***Solar Energy:*** Solar irradiation, solar energy conversion, solar energy collector.

<table>
<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 thermal system design and management.
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="3">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td></tr>
<tr><td>1. Lecture</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Tutorial</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>3. Homework assignment</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>4. Case study report and Presentation</td><td>√</td><td>√</td><td>√</td></tr>
</table>
</td>
</tr>
</table>

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	20%	√	√	√
2. Test	20%	√	√	
3. Case study report and presentation	20%	√	√	√
4. Examination	40%	√	√	√
Total	100%			

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

Overall Assessment:

$0.40 \times$ End of Subject Examination + $0.60 \times$ 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	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. Cengel Y. A., *Heat Transfer*, McGraw-Hill, latest edition.
2. Rohsenow W. M., Hartnett J. P. and Ganić E. N., *Handbook of Heat Transfer Applications*, New York: McGraw-Hill, latest edition.
3. Incropera F. P. and DeWitt D. P., *Fundamentals of Heat and Mass Transfer*, John Wiley & Sons, Inc. latest edition.

Subject Description Form

Subject Code	ME570
Subject Title	Advanced Product Mechatronics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in fundamentals of system dynamics and automatic control, familiar with control systems, computer language in Matlab. Exclusion: ME553 Product Mechatronics
Objectives	To provide students with knowledge of designing and analyzing intelligent product embedded with microcontrollers. Students will learn to integrate sensors, microcontrollers, and actuators to design intelligent products.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of advanced mechatronics in product design and analysis; b. apply their knowledge, skills and hand-on experience to design, develop, manufacture, and analyze new products with advanced mechantronics features or functions for desired needs; c. extend their knowledge of advanced mechatronics to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Mechatronic System:*** Configuration of mechatronic systems; sensors and transducers, and signal conditioning circuits; actuators: electrical, mechanical and pneumatic; drivers; measurement and guidance of moving parts. ***Signal Processing Techniques:*** Analog and digital filters; Nyquist sampling theorem; controller design and implementation; data converters (analog-to-digital, digital-to-analog); microcontrollers and their applications; interfacing and power sources. ***Mechatronic System Analysis:*** Design and implementation; problem definition; system requirement; integration and design criteria. ***Typical Case Studies and Projects of Mechatronic Systems:*** • Design of a home security system • Analysis and design of auto-focusing in a camera lens system • Skip control of a CD player • Programming and control of robots or CNC machines • Application of mechatronics to the design of smart toys or products • Intelligent control of home appliances • Integration of ultrasonic sensors, infrared sensors, actuators, and a • microcontroller in an AGV system. • Mechatronic systems with multiple microcontrollers ***Typical Laboratory Experiments:*** • Implementation and tuning of DC motor and stepper motor controllers • Implementation of an ultrasonic sensor system • Interfacing between microcontrollers (serial or parallel)

Teaching/Learning Methodology

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 product mechatronics.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	√

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, case study report and presentation	20%	√	√		√
3. Examination	60%	√	√	√	√
Total	100%				

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

Overall Assessment:

$0.60 \times$ End of Subject Examination + $0.40 \times$ 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	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	Textbooks: 1. *Design with Microprocessors for Mechanical Engineers* by Stiffler, McGraw-Hill 2. *Introduction to Mechatronics and Measurement Systems*, by Alciatore and Histand, McGraw-Hill 3. *Mechatronics,* by Necsulescu, Prentice Hall 4. *Mechatronics - Electromechanics and Controlmechanics*, by Mill, Springer-Verlag 5. *Mechatronics - Electronic Control Systems in Mechanical Engineering*, by Bolton, Addison Wesley 6. *Mechatronics - Electronics in Products and Processes*, by Bradley, et al., Chapman and Hall 7. *Mechatronics - Mechanical System Interfacing*, by Auslander and Kempf, Prentice Hall 8. *Mechatronics System Design*, by Shetty and Kolk, PWS Publishing Journals: 1. *Transactions on Mechatronics*, IEEE and ASME 2. *Transactions on Industrial Electronics*, IEEE 3. *Transactions on Instrumentation and Measurement*, IEEE

Subject Description Form

Subject Code	ME571
Subject Title	Corrosion Control
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Engineering Materials. Exclusion: ME538 Corrosion Controls in Pollution Management
Objectives	To provide students with comprehensive knowledge about corrosion/ materials degradation and preventive methodologies.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of metal corrosion and protection technology; b. think critically and holistically in dealing with real corrosion problems, and generate practical solutions; and c. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Significance of Corrosion and Materials Degradation:*** Definitions and forms of corrosion and materials degradation; implications to economy and human society. ***Oxidation & Its Control:*** Oxidation at elevated temperature; thermodynamics and kinetics of oxidation; oxide structures; oxidation rate; effects of alloying; high temperature alloys and coatings for oxidation control. ***Corrosion Theory:*** Structure of water and aqueous solution; concept of pH; thermodynamics of corrosion; electrodes and electrode potentials; Nernst equation; corrosion products and passivity; classification of corrosion; corrosion rate. ***Metallurgical Cells and Environmental Cells:*** Effect of purity and crystal defects; galvanic corrosion; dealloying; stress cell and concentration cells; effect of velocity and temperature; crevice corrosion; pitting; microbial corrosion. ***Corrosive-mechanical Interaction:*** Erosion corrosion; corrosive wear; corrosion fatigue; hydrogen damage; stress corrosion cracking. ***Protective Coatings:*** Surface preparation; electrodeposition; hot-dip coatings; conversion coatings; paint coatings for metals. ***Corrosion Control of Common Metals:*** Iron and steels; aluminium and its alloys. ***Corrosion Control in Aviation:*** Airframes; gas turbine engines. ***Corrosion Control in Automobile:*** Automobile bodies, engines, and bright trim. ***Corrosion Control in Food Processing:*** Tinplate for food and beverage cans; dairy industries; brewing. ***Corrosion Control in Building Construction:*** Structures of buildings; cladding; metal roofs; siding and flashing; pumping and central heating; timber; leisure pool. ***Materials Selection and Design for Corrosion Control*** **Laboratory works:** • AFM examination of surface morphology • Corrosion rate measurement of steel • Oxidation kinetics of copper

Teaching/Learning Methodology

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 corrosion control.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes		
	a	b	c
1. Lecture	√	√	√
2. Tutorial	√	√	√
3. Homework assignment	√	√	√
4. Case study report and presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
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	42 Hrs.
▪ Case study report preparation and presentation	24 Hrs.
Total student study effort	105 Hrs.

Reading List and References

1. David Talbot and James Talbot (1998), "*Corrosion Science and Technology*", *H749.H34B78*, latest edition.
2. Denny A. Jones (1996), *"Principles and Prevention of Corrosion", TA462.J59,* latest edition.
3. Mars G. Fontana (1986), *"Corrosion Engineering", TA418.74.F6*, latest edition.
4. J.C. Scully (1990), *"The Fundamentals of Corrosion", TA462.S39*, latest edition.
5. Samuel A. Bradford (2001), *"Corrosion Control", TA462.B648*, latest edition.

Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME572</td></tr>
<tr><td>Subject Title</td><td>Design for Sustainable Development</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 engineering and applied sciences.</td></tr>
<tr><td>Objectives</td><td>To provide students with knowledge of design for sustainable development.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
a. possess the knowledge of environmental issues in the manufacturing environment, environmental management system and design for environment;
b. apply their knowledge, skills and hand-on experience to design for environment; and
c. have recognition of the need for, and an ability to engage in life-long learning.</td></tr>
<tr><td>Subject Synopsis/
Indicative Syllabus</td><td>Introduction to Environmental Issues in the Manufacturing Environment: Global environmental issues; environmental issues in the manufacturing environment: air quality, water quality and hazardous waste issues; impact on our environment and health hazards; sustainable development.
Environmental Management System: Environmental management standards; development of ISO 14000 series; design and implementation of environmental management system; environmental auditing, environmental performance, life cycle assessment, and environmental labels and declarations; environmental products declarations.
Design for Environment: Introduction to design for environment; product life cycle; eco-design and traditional design; sustainable product design; integrated product and process design and development; eco-design strategies; packaging and distribution. materials recycling.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="3">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td></tr>
<tr><td>1. Lecture</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Tutorial</td><td>√</td><td>√</td><td></td></tr>
<tr><td>3. Homework assignment</td><td>√</td><td>√</td><td></td></tr>
<tr><td>4. Case study report and presentation</td><td>√</td><td>√</td><td>√</td></tr>
</table>
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 design for sustainable development.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.</td></tr>
</table>

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	15%	√	√	
2. Test	20%	√	√	
3. Case study report and presentation	15%	√	√	√
4. Examination	50%	√	√	
Total	100%			

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

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	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. Allen D.T. and Shonnard D.R., *Green Engineering- Environmentally Conscious Design of Chemical Processes*, Prentice Hall, latest edition.
2. Azapagic A. and Perdan S., *Sustainable Development in Practice.* John Wiley, latest edition.
3. Block M.R., *Effective Implementation of ISO 14001*, ASQ Quality Press, latest edition.
4. Fiksel J., *Design for Environment: Creating Eco-Efficient Products and Processes*, McGraw Hill, latest edition.
5. Giudice F., Rosa G.L. and Risitano A., *Product Design for the Environment: A Life Cycle Approach*, CRC Press, latest edition.
6. Goosen M.F.A., Schaffner, F.C., Laboy-Nieves, E.N. and Abdelhadi, A.H., *Environmental Management, Sustainable Development and Human Health*, CRC Press, latest edition.
7. Kinsella J. and McCully, A.D., *Handbook for Implementing an ISO 14001 Environmental Management System: a Practical Approach*, Shaw Environmental, latest edition.
8. Morris A.S., *ISO14000 Environmental Management Standards- Engineering and Financial Aspects*, John Wiley & Sons Ltd., latest edition.
9. Piper L., Ryding S.O. and Henricson C., *Continual Improvement with ISO14000*, IOS Press, latest edition.
10. Sheldon C. and Yoxon M., *Environmental Management Systems: a Step-by-Step Guide to Implementation and Maintenance*, Earthscan, latest edition.
11. Wright R.T., *Environmental Science: Toward a Sustainable Future*, Pearson/Prentice Hall, latest edition.

Journals:

	• International Journal of Sustainable Development and Planning, WIT Press. • International Journal of Sustainable Engineering, Taylor & Francis. • Sustainable Development, Wiley InterScience. • The Journal of Sustainable Product Design, Springer.

Subject Description Form

Subject Code	ME573
Subject Title	Project on Product Design and Management
Credit Value	3
Level	5
Pre-requisite / Co-requisite/ Exclusion	Students should have basic knowledge in Engineering and Applied Sciences.
Objectives	The subject helps student to learn, through a capstone project, how to carry out market analysis and how to manage a project. Through this project, the student will develop teamwork skills and product development abilities.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Think critically and holistically in dealing with product design project with real products, and generate realizable solutions. b. Possess state-of-the-art knowledge and skills in the area of project on product design and management.
Subject Synopsis/ Indicative Syllabus	***Overview of Marketing:*** Market needs research; dynamic marketing environment; identification and selection of markets; price determination and pricing strategies; knowledge of user requirements. ***New Product Management:*** Product life cycle; product life management; user-centered and market-driven approaches; team dynamics, budget, specifications and time management techniques; quality assurance and ISO. risk management. ***Capstone Project:*** A group product design project. *Capstone project assessment:* • Feasibility study report; • Creativity, design considerations, analysis and work accomplishment; • Group discussion on the progress (Peer evaluation is required.) • An interim group oral presentation. • A formal written group report and an oral presentation at the end of the study, effort of every member in the same project group should be clearly acknowledged.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, assignments, and group product design project.
2. The continuous assessment is aimed at providing students with integrated knowledge required for product design and management.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes	
	a	b
1. Lectures	√	√
2. Tutorials	√	√
3. Assignments	√	√
4. Group product design project	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed	
		a	
1. Group assessment (Interim oral presentation & report, final project report & oral presentation)	50%	√	√
2. Individual assessment (Project proposal, conceptual designs, final oral presentation, peer assessment, test)	50% (30% for the Test)	√	√
Total	100%		

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

Overall Assessment: 1.0 □ Continuous Assessment

The subject learning outcomes are achieved through a group product design project undertaken by the students. Each group consists of 3 to 4 students. Both individual and group level contributions are necessary to complete the project. The assessments are done based on the written reports, oral presentations and assignments submitted by the students periodically. The evaluations and the feedback provided will help the students in self-monitoring and fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learnt.

Student Study Effort Expected

Class contact:	
• Lecture	16 Hrs.
• Tutorial/Consultation	23 Hrs.
Other student study effort:	
• Self Study/Group activities	45 Hrs.
• Project report preparation and presentation	21 Hrs.

	Total student study effort	105 Hrs.
Reading List and References	Textbook: 1. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, McGraw-Hill, 2008. References: 1. George E. Dieter and Linda C. Schmidt, Engineering Design, McGraw- Hill, 2009. 2. Product realization [electronic resource]: a comprehensive approach/Mileta M. Tomovic, Shaoping Wang, (http://www.springerlink.com/content/978-0-387-09481-6) 3. E-Book: Project management in new product development [electronic resource]/Burce T. Barkley, Sr. (http://lib.myilibrary.com/browse/open.asp?id=110947&loc=)	

Subject Description Form

Subject Code	ME574
Subject Title	Product Noise Control
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Dynamics and Thermofluids.
Objectives	To provide the advanced knowledge of noise radiation mechanisms including the vibration of moving parts and flow induced noise. The principle and methodology of noise control, in particular during designing a product, are then demonstrated with a few of examples.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of noise radiation mechanisms and noise/vibration control principles; b. apply their knowledge, skills and hand-on experience to design, develop, manufacture, and analyze new products by considering noise/vibration control and keeping aware of the environmental issues, existing regulation and policies concerning noise control; c. extend their knowledge of noise radiation mechanism and noise/vibration control principles to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Acoustic Quality of Products:*** Basics of sound radiation; hearing and hearing loss; A-weighting; Characterization of sound sources and sound propagation; ISO standards of noise source testing for typical products and industrial facilities, use of anechoic and reverberation chambers. ***Basic Sources of Product Noise:*** Mechanisms, estimates and measurement of noise radiated by a variety of mechanical equipment such as fans, blowers, compressors, pumps, cooling towers, turbines and jets; flow-induced noise. ***Noise Abatement Techniques and Applications:*** Sound absorption by fibrous materials, sound reflection by impedance discontinuities, active noise control; noise isolation, enclosures, control of flow noise in fans, pumps and compressors, silencers/mufflers and other control of noise along its propagation path. ***Vibration Control and Applications:*** Structural response to excitation, vibration and flutter of engineering structure; active and passive vibration control and suppression; structural vibration control for engineering products, including bridge, aircraft, etc.

Teaching/Learning Methodology

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 product noise control.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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. Beranek L. L. and Ver I. L. (editors), *Noise and Vibration Control Engineering, principles and applications*. New York: Wiley, latest edition.

	2. Pierce A. D., *Acoustics: An Introduction to its Physical Principles and Applications*. Woodbury, N.Y. : Acoustical Society of America, latest edition. 3. Fahy F., *Sound Intensity*. London : E & FN Spon, latest edition. 4. Koopmann G. H., *Designing Quiet Structures: A Sound Power Minimization Approach*. San Diego : Academic Press, latest edition. 5. Crocker M. J. (editor), *Handbook of Acoustics*. New York : Wiley, latest edition.

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Subject Description Form

Subject Code	ME576
Subject Title	Turbulent Flows and Aerodynamics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in fundamental fluid mechanics. Exclusion: ME568 Flow System Design and Analysis
Objectives	To provide students with knowledge of advanced fluid mechanics and aerodynamics knowledge.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge in the area of advanced fluid dynamics, typical engineering flows and aerodynamics; b. apply their knowledge, skills and hand-on experience, gained from the subject, to the design and analysis of engineering flow and aeronautical systems; c. extend their knowledge of mechanical engineering to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***A Review of Kinematics and Dynamics of Flow Fields:*** Eulerian and Lanrangian descriptions; rotational and irrotational flows; acceleration of a fluid particle; Euler's equation; Bernoulli's equation; conservation equations of mass; momentum and energy. ***Time-averaged Conservation Equations:*** Reynolds-averaged equations of mass; momentum and energy conservations; turbulence modelling: large-eddy simulation, eddy-viscosity hypothesis, mixing length models and two equation transport models. ***Typical Turbulent Flows:*** Wakes of bluff bodies, plane and round jets, mixing layers, boundary layers, pipe and channel flows. ***Compressible Flows:*** Subsonic compressible flows. Transonic, supersonic and hypersonic flows. Stagnation properties; one-dimensional isentropic flow; isentropic flow through nozzles; shock waves and expansion waves. ***Aerodynamic Characteristic of Airfoils and Wings:*** Vortex street; vortex street in thin-airfoil theory; properties of the symmetrical airfoil; properties of the cambered airfoil; flapped airfoil. Wings of finite span: lift, drag, lift/drag ratio.

Teaching/Learning Methodology

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 flow and aerodynamic system design and analysis.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√
4. Case study report and presentation	√	√	√	

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. Case study report and presentation	20%	√	√	√	
3. Examination	60%	√	√	√	√
Total	100%				

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

Overall Assessment:

$0.60 \times$ End of Subject Examination + $0.40 \times$ Continuous Assessment

The continuous assessment consists of three components: homework assignments 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

1. Cengel Y A, Cimbala J M, *Fluid Mechanics: Fundamentals and Applications*. McGraw Hill, latest edition.

References	2. Kuethe A M, Chow C-Y, *Fundamentals of Aerodynamics: Bases of Aerodynamic Design*, John Wiley & Sons, Inc. latest edition. 3. Rathakrishnan E, *Gas Dynamics*, PHI Learning Private Ltd., latest edition.

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Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME577</td></tr>
<tr><td>Subject Title</td><td>Advanced Aircraft Structures</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>Exclusion: AAE5202 Advanced Aircraft Structures and Materials</td></tr>
<tr><td>Objectives</td><td>To provide students the key knowledge relevant to the structures and composite materials in aircraft; to provide students with tools of stress analysis to formulate and solve engineering problems in aircraft structures.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
a. demonstrate a good understanding of key aspects of aircraft structures, components and systems;
b. analyze an aircraft structure subject to a combined state of loading using stress analysis tools;
c. apply failure criteria to analyze an aircraft structure subject to loading;
d. formulate and solve problems concerning compression/tension, bending, torsion and buckling in aircraft structures;
e. understand mechanical behaviors of composites used in aircraft;
f. analyze the effects of various loads or displacement boundary conditions on aircraft structures; and
g. gain appreciation of the wide design flexibility composites in aircraft.</td></tr>
<tr><td>Subject Synopsis/
Indicative Syllabus</td><td>Characteristics of Aircraft Structures and Materials: Structural elements in aircraft. Wing, fuselage, tail and landing gear. Aircraft materials.
Elasticity: Stress and strain. Equations of equilibrium. Principal stresses. Linear stress-strain relations. Elastic strain energy. St. Venant’s principle. Thin plate theory.
Loads Applied on Aircraft: Compression/tension. Torsion. Bending. Closed single-cell thin-walled sections. Transverse shear stress. Flexural shear in thin-walled sections and in open thin-walled section. Buckling of columns. Aircraft structures under combined loading.
Failure Criteria for Isotropic Materials: Strength criteria for brittle materials. Yield criteria for ductile materials. Fracture mechanics. Stress intensity factor. Fatigue.
Aircraft Composites: Classification and characteristics of composite materials. Mechanical behavior of composite materials. Interface properties. Processing and Fabrication techniques for aircraft composites. Analysis of Lamina and Laminates Failures of composites.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Lectures are used to deliver the fundamental knowledge in relation to aircraft structures and composites (outcomes a to g).
Tutorials are used to illustrate the application of fundamental knowledge to practical situations (outcomes a to g).
<table>
<tr><td rowspan="2">Teaching/Learning Methodology</td><td colspan="7">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td></tr>
<tr><td>Lecture</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Tutorial</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
</table></td></tr>
</table>

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed						
		a	b	c	d	e	f	g
1. Examination	50%	√	√	√	√	√	√	√
2. Assignment and test	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

Examination is adopted to assess students on the overall understanding and the ability of applying the concepts. It is supplemented by continuous assessment including assignments and closed-book tests. The continuous assessment is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus.

All assigned homework inclusive of any computer problems should be worked independently. It is the students' responsibilities to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a zero score will be assigned.

Student Study Effort Expected

Class contact:	
▪ Lecture	24 Hrs.
▪ Tutorial/Case Study	15 Hrs.
Other student study effort:	
▪ Course work	42 Hrs.
▪ Self-study	25 Hrs.
Total student study effort	106 Hrs.

Reading List and References

1. C.T. Sun, Mechanics of Aircraft Structures, John Wiley & Sons, 1998.
2. T.H.G. Megson, Aircraft Structures for Engineering Students, Elsevier, 2007.
3. R.F. Gibson, Principles of Composite Material Mechanics, McGraw-Hill International Editions, 1994.
4. I. Moir and A.G. Seabridge, Design and Development of Aircraft Systems – An Introduction, AIAA Education Series, 2004.

Subject Description Form

Subject Code	ME578
Subject Title	Aircraft Design
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Exclusion: AAE5203 Aircraft Design and Certification
Objectives	To provide students with the key knowledge relevant to the process and principle of flight vehicle design, and the capacity to formulate the design requirements for a flight vehicle using modern engineering tools; to provide students with the opportunity to conduct flight vehicle system design studies from aerodynamics, propulsion, structure, stability, and performance perspectives; to develop management skills in teamwork and develop skills in carrying out detailed design tasks.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand fundamental concepts and constraints during a flight vehicle design process; b. evaluate common flight vehicle configurations; c. design and layout flight vehicle major components; d. understand aerodynamic, structural and engine characteristics; e. identify key design features of different types of flight vehicles; f. design and sizing flight vehicles that meets certain requirements; g. develop a simple design program; h. understand airworthiness and safety;
Subject Synopsis/ Indicative Syllabus	***Introduction to Aircraft Design:*** Design method and basic requirements. Evolution of aircraft design and its performance: a brief history. Overview of aircraft design cycle and process. ***Aircraft Configuration:*** Advantages and drawbacks of conventional and alternative configurations. Considerations for special aircraft. Primary considerations for fuselage, wing, and tail design. ***Jet propulsion:*** Basic considerations in the analysis of jet propulsion. Gas-turbine engines. Inter-cooling. Reheating. Regeneration. Ideal jet-propulsion cycles. Modifications to turbojet engines. ***Aerodynamic consideration of aircraft design:*** Fundamentals of aerodynamics. Flow separation. Friction and pressure drag. Parallel flow over flat plate and wings. Airfoils. Finite wings. Drag and lift. Lift-to-drag ratio. Dependence of lift and drag on the angle of attack. Flapped airfoils. End effects of wing tips. Induced drag. ***Structural consideration of aircraft design:*** Fundamentals of aerospace structures. Airframe basics. Aerospace materials. Stiffened panels. Trusses. Buckling. ***Sizing and Costing:*** Internal layout. Structures and weight. Geometry constraints. Sizing equation. Weight fraction method. Weight and balance. Cost analysis. Elements of life-cycle cost. Cost-estimating methods. Operations and maintenance

costs. Cost measures of merit.

Main Components Selection and Design: Selection and design of main components such as fuselage, wing, tail, and landing gear. Calculation and design of control surfaces such as aileron, elevator, and rudder.

Airworthiness and Safety: Airworthiness requirements. Load factor determination. Aircraft safety. Airframe loads. Designing against fatigue. Prediction of aircraft fatigue life.

Project practice: A design project will be carried out for students to learn the aircraft design process through practice.

Teaching/Learning Methodology

Lectures are used to deliver the fundamental knowledge in relation to aircraft design (outcomes a to h).

Tutorials are used to illustrate the application of fundamental knowledge to practical situations (outcomes a to h).

Teaching/Learning Methodology	Intended subject learning outcomes							
	a	b	c	d	e	f	g	h
Lecture	√	√	√	√	√	√	√	√
Tutorial	√	√	√	√	√	√	√	√
Final examination	√	√		√	√			√
Design project	√	√	√	√	√	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed							
		a	b	c	d	e	f	g	h
1. Design project 1	25 %	√	√			√		√	
2. Design project 2	25 %			√	√		√		√
3. Design project presentation	10 %	√	√	√	√	√	√	√	√
4. Final examination	40 %	√	√		√	√			√
Total	100 %								

Overall Assessment:

0.6 x Continuous Assessment + 0.4 x End of Subject Examination

The group project is used to assess all aspects of the course content as well as the students' capacities of self-learning and problem-solving and effective communication skill in English so as to fulfill the requirements of being aircraft design engineers.

Student Study Effort Expected

Class contact:	
▪ Lecture	24 Hrs.
▪ Tutorial/Case Study	15 Hrs.
Other student study effort:	
▪ Course work	42 Hrs.
▪ Self-study	25 Hrs.
Total student study effort	106 Hrs.

Reading List and References	1. D. Raymer, Aircraft Design: A Conceptual Approach. American Institute of Aeronautics and Astronautics, Inc., 2018. 2. S.A. Brandt, *et al*., Introduction to Aeronautics: A Design Perspective, American Institute of Aeronautics and Astronautics Inc., 2015. 3. J. Anderson, Introduction to Flight. McGraw Hill, 2015.

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Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME579</td></tr>
<tr><td>Subject Title</td><td>Aircraft Noise and Aeroacoustics</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 must have fundamental knowledge in fluid mechanics or aerodynamics.
Fundamental knowledge in acoustics is preferred.</td></tr>
<tr><td>Objectives</td><td>To provide students in-depth knowledge of the noise generation mechanisms of aircraft noise and its environmental issues. Analysis using aeroacoustic theory will be introduced.</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 in the area of aircraft noise;
b. apply their knowledge, skills and hand-on experience to analyze the noise generation of key aircraft components, its radiation and environmental consequences;
c. extend their ability to integrate various noise suppression techniques in achieving quiet design and operation of aircraft ; and
d. have recognition of the need for, and an ability to engage in life-long learning.</td></tr>
<tr><td>Subject Synopsis/
Indicative Syllabus</td><td>Noise Radiation from Aircraft: Aircraft noise descriptors. Human response to aircraft noise. Actions against aircraft noise. Noise certification and regulation.
Introduction to Aeroacoustic Theory: Equation of linear acoustics. Free-space Green’s function. Acoustics of point sources. Lighthill’s acoustic analogy and its extensions. Acoustics of turbulence near a rigid body. Radiation from compact and non-compact sources. Fuselage dynamics and cabin noise.
Noise Source Mechanisms: Airframe noise. Propeller noise. Fan and compressor noise. Turbine noise. Jet noise. Combustor noise. Interior noise.
Noise Control: Noise control at sources. Cabin noise control. Quiet aircraft design and operational characteristics. Quiet airport operation.</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 understanding and analysis of aircraft noise.
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>
</table>
</td></tr>
<tr><td>Assessment Methods in Alignment with</td><td>
<table>
<tr><td>Specific assessment methods/tasks</td><td>% weighting</td><td>Intended subject learning outcomes to be assessed</td></tr>
</table>
</td></tr>
</table>

Intended Learning Outcomes

		a	b	c	d
1. Homework assignment	20%	√	√	√	√
2. Test	20%	√	√		
3. Case study report and presentation or Laboratory	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 analysing 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

Textbooks:

1. Crighton, D. G., Dowling, A. P., Ffowcs Williams, J. E., Heckl, M., Leppington, F. G., *Modern Methods in Analytical Acoustics – Lecture Notes*, Springer, latest edition.
2. Goldstein, M. E., *Aeroacoustics*, McGraw-Hill, latest edition.
3. Howe, M. S., *Theory of Vortex Sound*, Cambridge University Press, latest edition.
4. Hubbard, H. H. (Ed.), *Aeroacoustics of Flight Vehicles – Theory and Practice*, *Vols. 1 & 2*, Acoustical Society of America, latest edition.
5. Nelson, P. M. (Ed.), *Transportation Noise Reference Book*, Butterworths, latest edition.
6. Pierce, A. D., *Acoustics – An Introduction to Its Physical Principles and Applications*, Acoustical Society of America, latest edition.
7. Smith, M. J. T., *Aircraft Noise*, Cambridge University Press, latest edition.

Journals:

1. *AIAA Journal*, American Institute of Aeronautics and Astronautics.
2. *International Journal of Aeroacoustics,* Multi-Science.
3. *Journal of the Acoustical Society of America*, Acoustical Society of America.
4. *Journal of Sound and Vibration*, Academic Press.

Subject Description Form

Subject Code	ME5201
Subject Title	Hydrogen and Fuel Cells
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To understand the importance of the use of hydrogen energy in solving energy and environmental problems we are facing. 2. To provide students with fundamental knowledge of hydrogen production and utilization technologies. 3. To design and analyze fuel cell application systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) understand concepts and components of hydrogen production technologies. b) apply the fundamental knowledge of hydrogen production technologies for applications and innovations. c) obtain comprehensive knowledge and skills on fuel cell technologies. d) design and evaluate fuel cell systems. e) have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Introduction***: renewable energy resources and utilization, climate change, energy conversion and storage; carbon-neutral goal ***Hydrogen***: hydrogen economy; hydrogen energy; conventional hydrogen production technologies; grey hydrogen; blue hydrogen; green hydrogen; water electrolysis; electrolytic cell; alkaline liquid electrolyte water electrolysis; proton exchange membrane water electrolysis; photocatalysis and photoelectrochemical cells for hydrogen production; hydrogen storage and utilization ***Fuel cell technologies:*** thermodynamics and kinetics; electrochemical cells; classifications; working principles; basic components; nanomaterials and catalysts; reaction mechanisms; porous electrodes; membranes; membrane electrode assemblies; bipolar plates; cell designs; proton exchange membrane fuel cells; direct alcohol fuel cells; single-cell and stack

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, in-class tests, report & presentation, and final examination.

2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for hydrogen and fuel cells.

3. Technical/practical examples and problems will be raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes				
	a	b	c	d	e
1. Lecture	✓	✓	✓	✓	✓
2. Tutorial	✓	✓	✓	✓	
3. Report & presentation		✓		✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
1. In-class tests	20%	✓	✓	✓	✓	
2. Homework	10%	✓	✓	✓	✓	
3. Project	20%		✓		✓	✓
4. Examination	50%	✓	✓	✓	✓	
Total	100 %					

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

Overall Assessment:

0.50 × Examination + 0.50 × Continuous Assessment

1. The continuous assessment will comprise three components: homework assignment (10%), team project (20%) and several in-class tests (20%). They are aimed at evaluating their understandings on hydrogen and fuel cell systems and enhancing the integration of their knowledge learnt.

2. The examination (50%) will be used to assess the knowledge acquired by the students for understanding and analysing the problems critically and independently, and to determine the degree of achieving the subject learning outcomes.

Student Study Effort Expected	Class contact:	
	▪ Lecture	30 Hrs.
	▪ Tutorial	9 Hrs.
	Other student study effort:	
	▪ Self-learning	55 Hrs.
	▪ Report and presentation	21 Hrs.
	Total student study effort	115 Hrs.
Reading List and References	*Books*: A.L. Dicks, D.A.J. Rand, *Fuel Cell Systems Explained*, Wiley, latest edition. J. Newman, K.E. Thomas-Alyea, *Electrochemical Systems*, Wiley, latest edition. *Journals*: *International Journal of Hydrogen Energy*, Elsevier. *Journal of Power Sources*, Elsevier. *Fuel Cells*, Wiley. *Journal of Fuel Cell Science and Technology*, The American Society of Mechanical Engineers (ASME). *Applied Energy*, Elsevier.	

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Subject Description Form

Subject Code	ME5202
Subject Title	Solar and Wind Engineering
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To understand the importance and global trend of solar and wind energy in solving the energy and environmental problems we are facing. 2. To provide students with fundamental knowledge of solar and wind resources, energy conversion principles, solar and wind system designs and operations. 3. To enable students to design and analyze solar and wind energy systems, and corresponding hybrid systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) understand the concepts and components of solar and wind resources and systems; b) apply the fundamental knowledge of solar and wind engineering for applications and innovations; c) design and evaluate different types of solar and wind energy systems; d) obtain comprehensive knowledge and skills on selected topics in solar and wind engineering. e) have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Introduction***: renewable energy resources; global trend; solar and wind technologies; environmental impact; overview of related heat and mass transfer topics. ***Wind Energy:*** wind characteristics; extraction characteristics; wind turbines; wind farm aerodynamics; power generation; on-shore and off-shore wind farms. ***Solar Energy:*** solar radiation; radiation characteristics of materials; photovoltaic applications; solar thermal applications. ***Energy Storage:*** sensible and latent heat storage; chemical energy storage; battery storage; hydroelectric and compressed air. ***Grid Planning and Operations:*** renewable power integration into power grid and its related issues; micro grid; smart grid; power dispatching; distributed generation and automation system.

	Solar and Wind Forecasting: impact of solar and wind forecasting on grid management; forecasting basics; physical and data - driven forecasting methodologies.
Teaching/Learning Methodology	1. The teaching and learning methods include lectures sessions, homework assignments, project, site visit and examination. 2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for solar and wind engineering. 3. Technical/practical examples and problems will be raised and discussed in lecture sessions. 4. A team project with report and presentation will be used to enhance students' understanding of the subject contents and practice presentation skills. 5. A site visit to a solar and wind farm will further provide an opportunity for students to understand the various components of a commercial solar and wind system as well as the operations of such system.

Teaching/Learning Methodology	Intended subject learning outcomes				
	a	b	c	d	e
1. Lectures	✓	✓	✓	✓	✓
2. Homework assignment	✓	✓	✓		
3. Project report and presentation				✓	✓
4. Site visit				✓	

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
1. Homework	15%	✓	✓	✓		
2. Project	20%				✓	✓
3. Test	15%	✓	✓	✓		
4. Examination	50%	✓	✓	✓		
Total	100 %					

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

Overall Assessment:

0.50 × Examination + 0.50 × Continuous Assessment

1. The continuous assessment will comprise two components: team project (20%), test (15%) and homework (15%). The team project, test and homework are aimed at evaluating their understandings on

<table>
<tr><td></td><td colspan="2">solar and wind systems and enhancing the integration of their knowledge learnt.
2. The examination (50%) will be used to assess the knowledge acquired by the students for understanding and analysing the problems critically and independently, and to determine the degree of achieving the subject learning outcomes.</td></tr>
<tr><td rowspan="8">Student Study Effort Expected</td><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>36 Hrs.</td></tr>
<tr><td>▪ Tutorial/Presentation</td><td>3 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Project/Assignments</td><td>40 Hrs.</td></tr>
<tr><td>▪ Self-study</td><td>25 Hrs.</td></tr>
<tr><td>▪ Site visit</td><td>6 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>110 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2">Duffie J.A. and Beckman W.A., Solar Engineering of Thermal Processes, Photovoltaics and Wind, Wiley, latest edition.

Rosa A.V. and Ordonez J.C., Fundamentals of Renewable Energy Processes, Elsevier Science, latest edition.

Petela R., Engineering Thermodynamics of Thermal Radiation: for Solar Power Utilization, McGraw Hill, latest edition.

Smets A. H., Jäger K., Isabella O., Swaaij, R. A. and Zeman M., Solar Energy: The Physics and Engineering of Photovoltaic Conversion, Technologies and Systems, UIT Cambridge Ltd., latest edition.

Nelson V. and Starcher K., Introduction to Renewable Energy, CRC Press, Taylor & Francis Group, latest edition.

Letcher T.M., Wind Energy Engineering: A Handbook for Onshore and Offshore Wind Turbines. Academic Press, latest edition.

Agarwal P., Mittal M., Ahmed J. and Idrees S.M., Smart Technologies for Energy and Environmental Sustainability. Springer, latest edition.

<u>Journals:</u>

1. Solar Energy, Elsevier Science Ltd.
2. Renewable Energy, Elsevier Science Ltd.
3. Energy, Elsevier Science Ltd.
4. Renewable and Sustainable Energy Reviews, Elsevier Science Ltd.
5. Journal of Renewable and Sustainable Energy, AIP Publishing Ltd.</td></tr>
</table>

Subject Description Form

Subject Code	ME5203
Subject Title	Green Combustion
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermodynamics.
Objectives	1. To provide knowledge about the state-of-the-art green combustion technologies; the basics of thermodynamics and chemical kinetics in green combustion; the fundamentals of various ideal reactors to investigate chemical kinetics in combustion; the modelling of ideal reactors; and the computation of thermochemical and kinetic parameters. 2. To provide hands-on training on kinetic combustion modelling and quantum chemistry computation.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. contribute to their professional competence in the area of green combustion, from both fundamental and practical perspectives; b. provide solutions for real combustion problems from molecular level to practical applications; c. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	**Green combustion technologies**: review of combustion pollutants and their environmental impact; green combustion strategies and green fuels to mitigate combustion environmental effects **Thermodynamics and chemical kinetics in green combustion**: collision theory; reaction theory; reaction rate order and reaction rates; chemical thermodynamics and equilibrium; simple and complex kinetic systems **Ideal reactors**: constant volume closed reactors; perfectly-stirred reactors; plug-flow reactors; governing equations and conservation laws; experimental set-up and control; advantages and limitations **Modelling of ideal reactors**: chemical kinetic effects; thermodynamic effects; transport effects; modelling software review **Computation of thermochemical and kinetic parameters**: statistical mechanics and molecular dynamics; electronic structure theory; group additivity; transition state theory and semi-classical treatments; master equation; modelling software review

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial/laboratory 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 green combustion applications.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Specific assessment methods/tasks	Intended subject learning outcomes		
	a	b	c
1. Lecture	√	√	√
2. Tutorial/Laboratory	√	√	√
3. Homework assignment	√	√	√
4. Case study report and presentation	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)		
		a	b	c
1. Homework assignment	20%	√	√	√
2. Test	20%	√	√	
3. Case study report and presentation	20%	√	√	√
4. Examination	40%	√	√	√
Total	100 %			

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

Overall Assessment:

0.40 × End of Subject Examination + 0.60 × 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 student 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 analysing 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	55 Hrs.
	▪ Case study report preparation and presentation	21 Hrs.
	Total student study effort	115 Hrs.
Reading List and References	Books: 1. Battin-Leclerc, F., Simmie, J. M., & Blurock, E. *Cleaner Combustion,* Springer International Publishing AG, latest edition. 2. Wright, M. R. *Introduction to Chemical Kinetics*. John Wiley & Sons, latest edition. 3. Lee, S., Speight, J. G., & Loyalka, S. K. (Eds.). *Handbook of Alternative Fuel Technologies*. CRC Press, latest edition. 4. Kauzmann, W. *Quantum Chemistry: An Introduction*. Elsevier, latest edition. 5. Turns S. R., *An Introduction to Combustion: Concepts and Applications*, McGraw-Hill, latest edition. Journals: 1. Combustion and Flame 2. Proceedings of the Combustion Institute 3. International Journal of Chemical Kinetics 4. Energy 5. Fuel 6. Energy & Fuels 7. Physical Chemistry Chemical Physics	

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Subject Description Form

Subject Code	ME5204
Subject Title	Batteries and Capacitors
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in mechanical engineering or chemical Engineering or electrical engineering or material engineering.
Objectives	To provide students with knowledge of electrochemical batteries and capacitors
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. have the knowledge of the electrochemistry, material science and engineering, characterizations, development and management for electrochemical batteries and capacitors; b. understand the current trend of the battery and capacitor research and development areas; and c. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Electrochemistry basics:*** electrochemical reactions; electrochemical thermodynamics; introduction to kinetics ***Electrochemical batteries:*** working principles; battery classification; battery materials; characterization techniques; current development trend. ***Electrochemical capacitor:*** working principles; capacitor materials; characterization; and current development trend. ***Battery development and management:*** typical battery development process from material to electrode, cell, pack, and battery; introduction to control and management.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorials, homework assignments, test, case study presentation and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for electrochemical batteries and capacitors.
3. Technical/practical examples and problems will be raised and discussed in class/tutorial sessions.

Teaching/Learning methodology	Intended subject learning outcomes		
	a	b	c
1. Lecture	✓	✓	✓
2. Tutorial	✓	✓	
3. Homework assignments/test/examination	✓	✓	
4. Case study report and presentation	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	15%	✓	✓	
2. Test	20%	✓	✓	
3. Case study report and presentation	15%	✓	✓	✓
4. Examination	50%	✓	✓	
Total	100 %			

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

Overall Assessment:

0.50 x End of Subject Examination + 0.50 x 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.

<table>
<tr><td rowspan="7">Student Study Effort Expected</td><td colspan="2">Class contact:</td></tr>
<tr><td>▪ Lecture</td><td>24 Hrs.</td></tr>
<tr><td>▪ Tutorial/Case study</td><td>15 Hrs.</td></tr>
<tr><td colspan="2">Other student study effort:</td></tr>
<tr><td>▪ Self-study</td><td>55 Hrs.</td></tr>
<tr><td>▪ Case study preparation and presentation</td><td>21 Hrs.</td></tr>
<tr><td colspan="2">Total student study effort</td><td>115 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2"><u>Textbooks:</u>
Tarascon J.-M. and Simon P., Electrochemical Energy Storage, Wiley, latest version.
Passerini S., Bresser D., Morretti A., and Varzi A., Batteries, Willey-VCH, latest version.
Kumugai S. and Tashima D., Electrochemical Capacitors, MDPI, latest version.
Gulbinska M.K., Lithium-ion Battery Materials and Engineering, Springer, latest version.
Warner J.T., The Handbook of Lithium-ion Battery Pack Design, Elsevier, latest version.
Plett G., Battery Management Systems: Volume 1, Battery Modelling, Artech, latest version
Kanamura K., Next Generation Batteries, Springer, latest version.
<u>Journals:</u>
Nature Energy, Nature Publishing Group.
Journal of Power Sources, Elsevier Science Ltd.
Journal of Electrochemical Society, Electrochemical Society.
Electrochimica Acta, Elsevier Science Ltd.</td></tr>
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Subject Description Form

Subject Code	ME5205
Subject Title	Advanced Energy Storage Technologies
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in thermofluids and electrochemistry.
Objectives	1. To enable students to establish a broad concept of energy storage. 2. To provide students with knowledge of advanced energy storage technologies.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. recognize the significance and benefits of energy storage. b. describe the underpinning principles and characteristics of different energy storage technologies. c. evaluate the performance and identify the limitations of various energy storage technologies. d. have recognition of the need for, and an ability to engage in life-long learning.
	Renewable Energy and Energy Storage: energy and sustainability; renewable energy sources and characteristics; role of energy storage; classifications of energy storage technologies. ***Mechanical Energy Storage:*** Pumped storage hydropower; compressed air energy storage; flywheel energy storage. ***Thermal Energy Storage:*** Sensible heat storage; latent heat storage; thermo-chemical energy storage. ***Electrochemical Energy Storage:*** lead-acid batteries; lithium-ion batteries and beyond; molten-salt batteries; redox flow batteries; metal-air batteries. ***Chemical Energy Storage:*** hydrogen storage; liquid fuel storage.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, case study report/presentation and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for energy storage technologies.
3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes to be assessed			
	a	b	c	d
1. Lecture	✓	✓	✓	✓
2. Tutorial	✓	✓	✓	
3. Homework assignment	✓	✓	✓	
4. Case study report and presentation	✓	✓	✓	✓

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. Test	10%	✓	✓	✓	
2. Homework assignment	20%	✓	✓	✓	
3. Case study report and presentation	20%	✓	✓	✓	✓
4. Examination	50%	✓	✓	✓	
Total	100%				

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

The continuous assessment consists of three components: homework assignments, interim 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:	
	▪ Formal lecture	24 Hrs.
	▪ Tutorial/case study	15 Hrs.
	Other student study effort:	
	▪ Self-study	55 Hrs.
	▪ Case study report preparation and presentation	21 Hrs.
	Total student study effort	115 Hrs.
Reading List and References	1. Huggins R.A., *Energy Storage*, Springer, latest edition. 2. Dincer I. and Rosen M., *Thermal Energy Storage: Systems and Applications*, Wiley, latest edition. 3. Barnes F.S. and Levine J.G., *Large Energy Storage Systems Handbook*, CRC Press, latest edition. 4. Tarascon J.M. and Simon P., *Electrochemical Energy Storage*, Wiley-ISTE, latest edition. 5. Brun K., Allison T.C. and Dennis R., *Thermal, Mechanical, and Hybrid Chemical Energy Storage Systems*, Academic Press, latest edition. 6. Sahoo U., *Energy Storage (Advances in Renewable Energy Series)*, Wiley-Scrivener, latest edition. 7. Jeguirim M., *Recent Advances in Renewable Energy Technologies*, Volume 1, Elsevier, latest edition. 8. Ting D. and Stagner J.A., *Compressed Air Energy Storage: Types, systems and applications*, The Institution of Engineering and Technology, latest edition. <u>*Journals*</u> • Journal of Energy Storage, Elsevier Science Ltd. • Energy Conversion and Management, Elsevier Science Ltd. • Energy, Elsevier Science Ltd. • Applied Thermal Engineering, Elsevier Science Ltd. • International Journal of Energy Research, John Wiley & Sons, Inc. • IEEE Power & Energy Magazine, IEEE. • Journal of Electrochemical Energy Conversion and Storage, American Society of Mechanical Engineers, USA.	

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Subject Description Form

Subject Code	ME5206
Subject Title	Advanced Materials for Clean Energy
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students are expected to have fundamental knowledge about materials and chemistry.
Objectives	1. To enable students to establish a general concept on the state-of-art clean technologies in renewable energy. 2. To enable students to establish a general concept on the advanced material preparation and characterization for sustainable energy storage and conversion. 3. To provide in-depth knowledge on the typical materials and their specific characteristics and performances towards renewable energy storage and conversion. 4. To enable students to know the practical application scenarios of clean energy.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a have state-of-the-art knowledge of advanced materials and advanced material design and synthesis for clean energy storage and conversion; b apply their knowledge, skills, and hands-on experience to design advanced materials for energy storage and conversion and improve their performances; c. extend their knowledge of the clean energy and material design to different situations of energy context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Introduction***: The development of renewable energy technologies; world resources and environmental considerations *versus* materials' selection; future trends in clean energy technology. ***Synthesis and Processing of Sustainable Materials***: Types of sustainable materials; materials structures; materials synthesis and characterization. ***Advanced Materials for Metal-ion Battery***: Cathode materials for Li-ion battery; anode materials for Li-ion battery; Na-ion battery. ***Advanced Materials for Solar Cells***: The principles of solar cells; materials for advanced solar cells including Si-solar cells, dye-sensitized solar cells, organic-inorganic hybrid materials, and perovskite solar cells. ***Advanced Materials for Fuel Cells***: The anode and cathode catalysts for H_2/O_2 fuel cells.

Advanced Materials for Electrochemical Water Splitting: Advanced materials for cathodic H_2 production; advanced materials for anodic O_2 production; full cell for water splitting.

Advanced Biomass and Their Applications: Biomass conversion technologies; corrosion resistant materials compatible with biofuels; catalysts for conversion of biomass to biofuel; coal liquefaction.

Advanced Materials for CO_2 Capture and Conversion: Solid sorbents for CO_2 capture; liquid sorbents for CO_2 capture; photo/electro-catalysis for CO_2 conversion.

Teaching/Learning Methodology

The main fundamental principles and key concepts of the subject will be delivered to students through lectures. The tutorials will be provided as complemented protocols to help students to have a deeper understanding of the lecture material. Laboratory visit will be provided to strengthen students' understanding and obtain a real experience on the materials design for energy storage and conversion. Assignments, in-class assignments will be used to evaluate students' ability in applying concepts and skills learned in the classroom.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	
3. Laboratory visit	√	√	√	√
4. Assignment	√	√	√	

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 & presentation	10%	√	√	√	√
4. Examination	50%	√	√	√	√
Total	100%				

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

Overall Assessment:

0.5 × End of Subject Examination + 0.5 × 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/Presentation	15 Hrs.
	Other student study effort:	
	▪ Self-Study	55 Hrs.
	▪ Case study report preparation and presentation	21 Hrs.
	Total student study effort	115 Hrs.
Reading List and References	**Textbooks:** 1. Bandarenka A.S., *Energy Materials: A Short Introduction to Functional Materials for Energy Conversion and Storage*, CRC Press, latest edition. 2. Liu J. L. and Bashir S., *Advanced Nanomaterials and Their Applications in Renewable Energy*, Elsevier, latest edition. 3. Shen P. K., Wang C. Y., Jiang S. P., Sun X. L. and Zhang J. J., *Electrochemical Energy, Advanced Materials and Technologies*, Taylor & Francis Group, latest edition. 4. Cheong K. and Apblett A., *Sustainable Materials and Green Processing for Energy Conversion*, Elsevier, latest edition. 5. Tong C., *Introduction to Materials for Advanced Energy Systems*, Springer, latest edition. 6. Dhoble S., Kalyani N., Vengadaesvaran B. and Arof A., *Energy Materials: Fundamentals to Applications*, Elsevier, latest edition. **Journals:** 1. Joule, Cell press. 2. Advanced Energy Materials, John Wiley & Sons. 3. Energy & Environmental Science, Royal Society of Chemistry.	

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Subject Description Form

Subject Code	ME5207
Subject Title	Electrochemical Energy Conversion Materials and Devices
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Basic knowledge in mechanical engineering or chemical Engineering or electrical engineering or material engineering.
Objectives	To provide students with knowledge of electrochemical energy storage devices and their functional materials
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. have the knowledge of the electrochemical fundamentals, electrochemical energy conversion material, electrochemical energy conversion devices (batteries and capacitors) and their management. b. understand the current trend of the battery and capacitor research and development areas. c. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Electrochemistry basics:*** electrochemical reactions; electrochemical thermodynamics; introduction to kinetics ***Electrochemical batteries and materials:*** working principles; battery classification; battery materials; characterization techniques; current development trend. ***Electrochemical capacitor and materials:*** working principles; capacitor materials; characterization; and current development trend. ***Battery development and management:*** typical battery development process from material to electrode, cell, pack, and battery; introduction to control and management.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorials, homework assignments, test, case study presentation and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for electrochemical batteries and capacitors.
3. Technical/practical examples and problems will be raised and discussed in class/tutorial sessions.

Teaching/Learning methodology	Intended subject learning outcomes		
	a	b	c
1. Lecture	✓	✓	✓
2. Tutorial	✓	✓	
3. Homework assignments/test/examination	✓	✓	
4. Case study report and presentation	✓	✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	15%	✓	✓	
2. Test	20%	✓	✓	
3. Case study report and presentation	15%	✓	✓	✓
4. Examination	50%	✓	✓	
Total	100 %			

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

Overall Assessment:

0.50 x End of Subject Examination + 0.50 x 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	15 Hrs.
	Other student study effort:	
	▪ Self-study	45 Hrs.
	▪ Case study preparation and presentation	21 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	**Textbooks:** Cornelia Breitkopf, Karen Swider-Lyons, Handbook of Electrochemical Energy, Springer, 2017 J.-M. Tarascon and P. Simon, Electrochemical Energy Storage, Wiley, 2015 S. Passerini, D. Bresser, A. Morretti, and A. Varzi, Batteries, Willey-VCH, 2020 S. Kumugai and D. Tashima, Electrochemical Capacitors, MDPI, 2020 M. K. Gulbinska, Lithium-ion Battery Materials and Engineering, Springer, latest version J. T. Warner, The handbook of lithium-ion battery pack design, Elsevier, latest version G. Plett, Battery Management Systems: Volume 1, Battery Modelling, Artech, latest version K. Kanamura, Next Generation Batteries, Springer, 2021 **Journals:** Nature Energy, Nature Publishing Group. Journal of Power Sources, Elsevier Science Ltd. Journal of Electrochemical Society, Electrochemical Society. Electrochimica Acta, Elsevier Science Ltd.	

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Subject Description Form

<table>
<tr><td>Subject Code</td><td>ME5510</td></tr>
<tr><td>Subject Title</td><td>Thermal Engineering</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</td></tr>
<tr><td>Objectives</td><td>To provide students with knowledge of engineering thermodynamics and heat transfer; to enable the students the ability of modeling, analyzing and solving the practical problems in thermal engineering.</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 in the area of thermal science and engineering, be able to apply their knowledge and skills in designing and developing products or engineering systems;
b. think critically and holistically in dealing with thermal problems, and generate practical solutions; and
c. recognize the need for, and engage in life-long learning.</td></tr>
<tr><td>Subject Synopsis/
Indicative Syllabus</td><td>Engineering Thermodynamics: Re-examination of engineering thermodynamics; temperature; entropy; exergy; fundamental laws; energy analysis; second law analysis.
Heat Transfer: Heat and heat transfer; conduction (fundamental laws, thermal conductivity, heat conduction equation); convection (governing laws, convective heat-transfer coefficient, scaling analysis, nondimensional governing numbers); radiation; heat exchangers (overall heat-transfer coefficient, thermal design).
Computational Fluid Mechanics: Governing equations of fluid flow and heat transfer; finite element method; finite difference method; finite volume method; other numerical techniques.
Case Study 1: Design of coffee/tea cups.
Case Study 2: Design of rice cookers.
Case Study 3: Flow and heat transfer in rotating machinery.
Case Study 4: Flow and heat transfer in thermal management systems of electronic equipment.
Case Study 5: Room ventilation design.</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 thermal science and engineering.
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="3">Intended subject learning outcomes</td></tr>
<tr><td>a</td><td>b</td><td>c</td></tr>
<tr><td>1. Lecture</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Tutorial</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>3. Homework assignment</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>4. Case study report and presentation</td><td>√</td><td>√</td><td>√</td></tr>
</table>
</td></tr>
</table>

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed		
		a	b	c
1. Homework assignment	20%	√	√	√
2. Test	20%	√	√	
3. Case study report and Presentation	20%	√	√	√
4. Examination	40%	√	√	√
Total	100%			

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

Overall Assessment:

$0.40 \times$ End of Subject Examination + $0.60 \times$ 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	21 Hrs.
▪ Tutorial/Case study	18 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. Cengel Y. A. and Boles M. A., *Thermodynamics: An Engineering Approach*, McGraw-Hill, latest edition.
2. Holman J. P., *Heat Transfer*, McGraw-Hill, latest edition.
3. Cengel Y. A., *Heat Transfer: A Practical Approach*, McGraw-Hill, latest edition.
4. Morris W. D., *Heat Transfer and Fluid Flow in Rotating Coolant Channels*, Wiley, latest edition.
5. Han J. C., Datta S., Ekkad S., *Gas Turbine Heat Transfer and Cooling Technology*, CRC Press/Taylor & Francis, latest edition.
6. Yeh L.T. and Chu R. C., Thermal Management of Microelectronic Equipment: Heat Transfer Theory, Analysis Methods, and Design Practices, ASME Press, latest edition.
7. Patankar S. V., *Numerical Heat Transfer and Fluid Flow*, McGraw-Hill, latest edition.
8. Fletcher C. A. J., Computational Techniques for Fluid Dynamics: A Solutions Manual, Springer-Verlag, latest edition.

Subject Description Form

Subject Code	ME5610
Subject Title	Air Pollution Engineering
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have basic knowledge in Thermofluids and Air Pollution. Exclusion: ME539 Treatments of Dust, Fume and Wastewater
Objectives	To provide the student with an in-depth understanding of the working principles and design features of air pollution control devices.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. possess state-of-the-art knowledge and skills in the area of air pollution control; b. apply their knowledge, skills and hand-on experience to evaluate different methods for reducing gaseous emission and reducing particulate emission; c. extend their knowledge of air pollution control to different situations of engineering context and professional practice; and d. have recognition of the need for, and an ability to engage in life-long learning.
Subject Synopsis/ Indicative Syllabus	***Nature of Gaseous and Particulate Pollutants in Air:*** Nature and composition of the atmosphere. Sources of air pollutants. Common gaseous pollutants in air and their chemical properties. Common particulates in air. Physical and chemical properties of aerosols. ***Principles and Design of Gaseous Pollution Control Devices:*** Processes for removal of pollutant gases and vapours. Adsorption: adsorption material, breakthrough time, adsorption zone velocity, regeneration. Absorption: packed bed scrubber, mass transfer process, NTU and HTU. Catalytic converter: catalysts, catalyst requirements for different applications, typical catalytic reactions for reducing pollutants. Design of absorber, absorber and catalytic converter. ***Principles and Design of Particulate Control Devices:*** Motion of particles: drag forces, equations of particle motion, settling velocity. Filters: surface filter and depth filter, filtering mechanisms, determination of filtering efficiencies. Cyclones: axial flow and tangential flow cyclones, equations governing motion of particles in the cyclone, determination of collection efficiency. Electrostatic precipitation: principle of electrostatic precipitation, equations governing motion of particles in electrostatic precipitator, determination of collection efficiency. Air purifiers: analysis of the design and function of air purifiers.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for air pollution control devices.
3. Technical/practical examples and problems will be raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes			
	a	b	c	d
1. Lecture	√	√	√	√
2. Tutorial	√	√	√	√
3. Homework assignment	√	√	√	√

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	15%	√	√	√	√
2. Test	35%	√	√		√
3. 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 will consist of two components: homework assignments and test. 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 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 subject learning outcomes.

Student Study Effort Expected

Class contact:	
▪ Lecture	30 Hrs.
▪ Tutorial/Case study/Laboratory	9 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. Nevers N. D., *Air Pollution Control Engineering*, McGraw-Hill, latest edition.
2. Heinsohn R. J. and Kabel R. L., *Sources and Control of Air Pollution*, Prentice Hall, latest edition.
3. Toole-O'Neil B., *Dry Scrubbing Technology for Flue Gas Desulfurization*, Kluwer Academic Publisher, latest edition.
4. Lewandowski, D. A., *Design of Thermal Oxidation Systems for Volatile Organic*

	Compounds, Lewis Publishers, latest edition. 5. Dickenson, T. C., *Filters and Filtration Handbook*, 4th edition, Elsevier Advanced Technology, latest edition. 6. Crittenden B. and Thomas, W. J., *Adsorption Technology and Design*, Butterworth Heinemann, latest edition. Journals • Environmental Science and Technology • Separation and Purification Technology • Aerosol Science and Technology • Journal of Aerosol Science • Process Safety and Environmental Protection • AICHE Journal

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