1. General Information

1.1 Programme Titles
Master of Philosophy in ME with Mechanical Engineering
Doctor of Philosophy in ME with Mechanical Engineering

1.2 Offering Department
Department of Mechanical Engineering

1.3 Final Awards
Doctor of Philosophy (PhD)
Master of Philosophy (MPhil)

1.4 Normal Period of Study

PhD Programme
Full-time: 36 months (or 48 months for students admitted with a Bachelor's degree)
Part-time: 72 months (or 96 months for students admitted with a Bachelor's degree)

MPhil Programme
Full-time: 24 months
Part-time: 48 months

2. Programme Structure: coursework credit and thesis requirements

Mode and level	*Number of credits required to complete before thesis submission*	*Credit limit of guided-study subjects*
Full-time and Part-time MPhil students	9 credits	No more than 4
Full-time PhD student with three-year normal study period Part-time PhD students with six-year normal study period	15 credits	No more than 6
Full-time PhD students with four-year normal study period Part-time PhD students with eight-year normal study period	22 credits	No more than 10

3. University Overarching Aims of Research Degree Programmes

The research degree programmes are designed in such a way to enable the student to:

3.1 acquire competence in research methods and scholarship; and
3.2 display sustained independent effort and independent original thought.

The PhD programmes also target to produce academics or industrial R & D professionals.

4. Learning outcomes for MPhil programme in Department of Mechanical Engineering

4.1 To develop the understanding of the basic methodologies applied in scientific research of ME disciplines;
4.2 To develop the ability to design and conduct scientific research, as well as analyze and interpret data;
4.3 To develop the ability to apply knowledge of mathematics, science and engineering to the ME disciplines; and
4.4 To develop the ability to disseminate the research outputs in a professional manner.
4.5 To prepare students for advanced study (such as PhD) or for industry position.

5. Learning outcomes for PhD programme in Department of Mechanical Engineering

5.1 To develop a systematic understanding of the substantial fundamentals and state-of-art technologies in ME discipline;
5.2 To develop in-depth understanding and specialize one or more research ethodologies and techniques in ME discipline;
5.3 To develop the ability to pose, analyze and solve scientific problems in mechanical Engineering, promoting the advance of the forefront of the discipline; and
5.4 To develop the ability to disseminate and promote research outputs.
5.5 To prepare students for academic or research position in the future.

6. English-language Requirements

Applicants from a university where the language of teaching /instruction /examination is NOT entirely in English should satisfy the minimum English proficiency requirements specified by both the University and individual Faculties.

Applicants who have not obtained a degree from a recognised university in which the language of instruction is English are required to obtain:

- An overall score of at least 6.5 (with score for the writing component at 6.0 or above) in the International English Language Testing System (IELTS); OR
- A Test of English as a Foreign Language (TOEFL) score of 80 or above for the Internet-based test (with a writing score of 23 or above) or 550 or above for the paper-based test (with a score of 4 or above in the Test of Written English).

All English language test scores are considered valid for five years after the date of the test.

7. Normal Study Pattern

Subjects Code	Subject Title	Credits	Compulsory /Elective	Remarks
N/A	Thesis	N/A	Compulsory	
HTI6801	Ethics: Research, Professional & Personal Perspectives	1	Compulsory	
ME6001 ME6002 ME6003 ME6004	Research Seminar I Research Seminar II Research Seminar III Research Seminar IV	*1 credit for each subject in this category:* 2-year MPhil - 2 credits 3-year PhD - 3 credits 4-year PhD - 4 credits	Compulsory	Students are recommended to complete one credit per year (for full-time students) or per two years (for part-time students) to fulfil the above-mentioned requirement, with an overall assessment grade of Pass and Fail. However, as deemed appropriate by the Chief Supervisor, they are allowed to complete at most two credits per year (for full-time students) or per two years (for part-time students to fulfil the research seminar credit requirement.
ME6006* ME6007* ** 2017 intake cohort or before may complete the 2-credit Practicum "ME6005" instead.*	Practicum I Practicum II	*1 credit for each subject in this category.* *(for PhD student only)*	Compulsory	PhD Students are allowed to complete these two credits any time before thesis submission. They can choose to complete these two credits in two different semesters or within the same semester, subject to the approval of the Chief Supervisor. Stipend recipients are allowed to fulfill part of their departmental training requirement through the completion of these compulsory training credits. For students who are required to undertake teaching supporting activities, they should be required to complete the training programmes organised by the EDC and ELC before the commencement of any teaching supporting activities.

Subjects Code	Subject Title	Credits	Compulsory /Elective	Remarks
ME6601 or ME6602	Advanced Engineering Mathematics or Computer Simulation Methods in Science and Engineering	3 credits	Compulsory	
ME6401 or ME6101 or ME6301	Combustion Science or Advanced Theory and Methods in Vibration Analysis or Properties, Applications and Modeling of Advanced Materials	3 credits	Compulsory	
	Free elective subjects offered to research degree students within or outside PolyU at level 6 or above, subject to the approval of the chief supervisor	*2-year FT MPhil: Not necessary to take the free elective* *3-year FT PhD or 6-year PT PhD: Need to attain at least 3 credits in this category in order to fulfill the minimum credit requirements for graduation.* *4-year FT PhD or 8-year PT PhD: Need to attain at least 9 credits in this category in order to fulfill the minimum credit requirement.*	Elective	

8. Relationship between the Programme Outcomes and Subjects

Programme Outcomes	Thesis	Ethics: Research, Professional & Personal Perspectives	Research Seminar	Practicum	Advanced Engineering Mathematics	Computer Simulation Method in Science & Engineering	Combustion Science	Advanced Theory and Methods in Vibration Analysis	Properties, Applications and Modeling of Advanced Materials	Free elective subjects
PhD										
To develop a systematic understanding of the substantial fundamentals and state-of-art technologies in ME discipline	**v**		**v**	**v**	**v**	**v**	**v**	**v**	**v**	**v**
To develop in-depth understanding and specialize one or more research methodologies and techniques in ME discipline.	**v**		**v**	**v**	**v**	**v**	**v**	**v**	**v**	**v**
To develop the ability to pose, analyze and solve scientific problems in mechanical Engineering, promoting the advance of the forefront of the discipline	v	v	**v**	**v**	**v**	**v**	**v**	**v**	**v**	**v**
To develop the ability to disseminate and promote research outputs	**v**	**v**	**v**	**v**	**v**	**v**	**v**	**v**	**v**	**v**
To prepare students for academic or research position in the future	**v**	**v**	**v**	**v**	**v**	**v**	**v**	**v**	**v**	**v**
MPhil										
To develop the understanding of the basic methodologies applied in scientific research of ME disciplines	**v**		**v**	**NA**	**v**	**v**	**v**	**v**	**v**	**NA**
To develop the ability to design and conduct scientific research, as well as analyze and interpret data	**v**		**v**	**NA**	**v**	**v**	**v**	**v**	**v**	**NA**
To develop the ability to apply knowledge of mathematics, science and engineering to the ME disciplines	v	v	**v**	**NA**	**v**	**v**	**v**	**v**	**v**	**NA**
To develop the ability to disseminate the research outputs in a professional manner	**v**	**v**	**v**	**NA**	**v**	**v**	**v**	**v**	**v**	**NA**
To prepare students for advanced study (such as PhD) or for industry position	**v**	**v**	**v**	**NA**	**v**	**v**	**v**	**v**	**v**	**NA**

9. Thesis Requirements

On completion of an approved programme of study and research, students must submit a thesis and defend it in an oral examination.

MPhil and PhD theses shall consist of the student's own work of his investigations and be integrated and coherent piece of work.

Research students should complete their coursework with a stipulated qualifying GPA before they can submit thesis for examination.

10. Credit Transfer

Credits which have already been used to contribute to an award should not be "transferred" to contribute to another award with the following exception:

3-year PhD students will be allowed to apply to transfer one credit from their previous studies in HTI6081 and one credit from their previous attendance in seminars.

11. Assessment Regulations

The assessment regulations confirm the University's General Assessment Regulations for credit-based programmes. The General Assessment Regulations for credit-based programmes are available from http://www.polyu.edu.hk/%7Eas/staff/problications_f.html.

12. This Programme Document is subject to review and changes which the programme offering Faculty/Department/School can decide to make from time to time. Students will be informed of the changes as and when appropriate.

13. This Document should be read together with the "Regulations and Administrative Procedures for the Degrees of MPhil and PhD" and the "Research Student Handbook".

Subject Description Forms

Subject offered by the Department of Mechanical Engineering

Subject Description Form

Subject Code	ME6001 ME6002 ME6003 ME6004
Subject Title	Research Seminar I Research Seminar II Research Seminar III Research Seminar IV
Credit Value	One credit per subject
Level	6
Pre-requisite/ Co-requisite/ Exclusion	N.A.
Objectives	To let the students to meet with leaders of different research fields and broaden their exposure to and knowledge of latest research and technology.
Intended Learning Outcomes	a. To develop substantial fundamentals and state-of-art technologies in ME discipline; b. To broaden their exposure to other disciplines so as to help developing in-depth understanding and specialize one or more research methodologies and techniques in ME discipline; c. To develop the ability to pose scientific problems in Mechanical Engineering; d. To develop the ability to disseminate and promote research outputs in a professional manner.
Subject Synopsis/ Indicative Syllabus	To be arranged in line with the departmental seminars.
Teaching/Learning Methodology	Full-time students are required to attend at least 10 research seminars per year, in addition to workshops/conferences, and to submit a report, to the Chief Supervisor, of no less than 1,500 words (excluding references) on one of the attended seminars every year. Part-time students are required to attend at least 10 research seminars per two years, in addition to workshops/conferences, and to submit a report, to the Chief Supervisor, of no less than 1,500 words (excluding references) on one of the attended seminars once every two years. The research seminars may or may not be organised by the host department and are expected to last not less than an hour each. The topic of the seminar reported on should not be related directly to the thesis title of the student. Chief Supervisors are required to assess the report (with a pass or failure grade). Students who failed to submit a report to the satisfaction of their Chief Supervisor are required to make a re-submission until a pass grade is obtained. The Chief Supervisor has to pass the record of the seminars attended by their students and the report with a pass grade to the Research Office for custody at the end of each academic year.

<table>
<tr><td></td><td>Students should be awarded one credit per year (for full-time students) or per two years (for part-time students) for completing the above-mentioned requirement, with an overall assessment grade of Pass and Fail.

The total credits need to be earned by students are listed as follows:

The total credits need to be earned by students are listed as follows:

2-year MPhil student needs to take Research Seminar I and II (2 credits in total)
3-year PhD student needs to take Research Seminar I, II and III (3 credits in total)
4-year PhD student needs to take Research Seminar I, II, III and IV (4 credits in total)</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td></td><td></td></tr>
<tr><td>Attendance</td><td>50%</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>No less than 1,500 words report</td><td>50%</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>Total</td><td>100%</td><td colspan="6"></td></tr>
</table>
</td></tr>
<tr><td>Reading List and References</td><td>N/A</td></tr>
</table>

July 14

Subject Description Form

Subject Code	ME6006 ME6007
Subject Title	Practicum I Practicum II
Credit Value	1 credit per subject
Level	6
Pre-requisite/ Co-requisite/ Exclusion	N.A.
Objectives	This subject is compulsory for PhD students. Aims to provide teaching experience and training opportunity to research students in order to widen their exposure for the development of their academic career.
Intended Learning Outcomes	a. To develop substantial fundamentals and state-of-art technologies in ME discipline; b. To broaden their exposure to other disciplines so as to help developing in-depth understanding and specialize one or more research methodologies and techniques in ME discipline; c. To develop the ability to pose scientific problems in Mechanical Engineering; d. To develop the ability to disseminate and promote research outputs in a professional manner
Subject Synopsis/ Indicative Syllabus	The nature of the training shall be related to teaching and research, and be relevant to the formal programme of study.
Teaching/Learning Methodology	The departmental training requirement for stipend recipients should be kept unchanged. As part of the programme requirement, all PhD students who are not provided with the Teaching Postgraduate Studentship (TPS), irrespective of funding source and mode of study, **must** complete two training credits before graduation. To earn one credit, students will be required to engage in teaching/research supporting activities assigned by the HoD/DoS or his/her delegate for 6 hours/week in any 13-week semester. Students are allowed to complete these two credits any time before they graduate. They can choose to complete these two credits in two different semesters or within the same semester, subject to the approval of the Chief Supervisor. Stipend recipients are allowed to fulfill part of their departmental training requirement through the completion of these compulsory training credits. For students who are required to undertake teaching supporting activities, they should be required to complete the training programmes organised by the Educational Development (EDC), English Language Centre/Chinese Language Centre (as required) and ELC before the commencement of any teaching supporting activities.

Assessment Methods in Alignment with Intended Learning Outcomes	At the end of the training session, an assessment report on the performance of the relevant student(s), with details of activities undertaken and an overall assessment grade of Pass or Fail.	
Student Study Effort Expected	The duties normally include: - Assistance with running of tutorials/seminars/workshops, and/or supervision of laboratory or practical work; - Assistance with grading of tests, assignments and examination papers; - Assistance with preparation of materials and resources for supporting teaching and learning; - Assistance with invigilation of University degree examinations; and - Assistance with other teaching and administrative duties, as deemed appropriate by the department.	6 hours/week in any 13-week semester.
Reading List and References	To be advised by the subject offering lecturers.	

January 2018

Subject Description Form

Subject Code	ME6101
Subject Title	Advanced Theory and Methods in Vibration Analysis
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Exclusion: ME536 Vibrations and Structure-borne Noise
Objectives	The subject aims: 1. To equip students with the knowledge of MDOF systems; 2. To introduce students with elements of analytical dynamics; 3. To introduce students with continuous models and advanced analysis methods.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students are expected to achieve the following outcomes: a. Able to understand and formulate the dynamic response of MDOF systems; b. Able to apply their knowledge of vibration theory and methods to model mechanical behavior and conduct modal analysis; c. Able to conduct analysis and design in sound and vibration systems with advanced analysis methods; d. Able to comprehend the theoretical aspects in the related literature.
Subject Synopsis/ Indicative Syllabus	***Introduction to Vibrations* -** Equivalent springs, dampers and masses; Nature of Excitations, and vibration about equilibrium points; Response of SDOF systems to nonPeriodic Excitations; Whirling of rotating shafts; Vibration isolation, energy dissipation and structural damping. ***Elements of Analytical Dynamics* -** Degree of freedom and generalized coordinates; The principle of virtual work and D'Alembert; The hamilton's principle; Lagrange's equations. ***Multi DOF Systems* -** Properties of the stiffness and Mass coefficients; Linear transformations – coupling; The eigenvalue problem; Orthogonality of modal vectors; Modal analysis. ***Continuous Models for Vibrations* -** Transverse vibration of strings; Vibration of beams; Vibration of plates; Wave Equation. ***Advanced Selective Topics* -** Advanced acoustics; Wave propagation and application; Nonlinear analysis methods (perturbation, harmonic balance, or Volterra series etc).
Teaching/Learning Methodology	Lectures and Tutorials

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	d		
1. Continuous Assessment	40%	√	√	√	√		
2. Final	60%	√	√	√	√		
Total	100%						

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

Student Study Effort Expected

Class contact:	
▪ Lecture (13 weeks and 3 hrs per week)	39 Hrs.
Other student study effort:	
▪ Precepts or Tutorials	26 Hrs.
▪ After-class reading	39 Hrs.
Total student study effort	104 Hrs.

Reading List and References

1. Leonard Meirovitch, Fundamentals of Vibrations, McGraw Hill, latest edition.
2. Haym Benaroya, Mechanical vibration, Prentice Hall, latest edition.

Subject Description Form

Subject Code	ME6301
Subject Title	Properties, Applications and Modeling of Advanced Materials
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	N.A.
Objectives	To provide students with theories, properties, applications and modeling methods of advanced composite materials, smart materials, and nano-materials.
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 applications of advanced composites, smart materials and nano-materials. e. understand advanced theories in mechanics of solids.
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; design issues. ***Selected Topics of Advanced Theories in Mechanics of Solids* -** such as Theory of Plasticity, Theory of Fracture Mechanics. ***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 applications of SMA. ***Nanomaterials* -** properties, applications and modeling of nano-materials. ***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	e
1. Lectures	√	√	√	√	√
2. Tutorials	√	√	√	√	√
3. Homework assignments	√	√		√	√
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	e
1. Homework assignments	15%	√	√		√	√
2. Mid-term test	25%	√				√
3. Mini-project/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:

1. The assessment is comprised of 50% continuous assessment and 50% examination.

2. The continuous assessment consists of three components: homework assignments, mid-term 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.

3. 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	33 Hrs.
	▪ Tutorial/Lab	6 Hrs.
	Other student study effort:	
	▪ Self Study	45 Hrs.
	▪ Mini-project/Case study report preparation and presentation	21 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*, McGRAW-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. 6. T.L. Anderson, *Fracture Mechanics: fundamentals and applications*, CRC Press Inc., latest edition. 7. A.S. Khan and S.J. Huang, *Continuum Theory of Plasticity*, John Wiley & Sons Inc., latest edition.	

July 14

Subject Description Form

Subject Code	ME6401
Subject Title	Combustion Science
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	N.A.
Objectives	1. To provide fundamental scientific aspects of combustion. 2. To develop sound understanding of relationships among fuels, combustion processes and pollutant emissions. 3. To develop knowledge for the evaluation of combustion, thermal and emission characteristics of a combustion process.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the combustion process between fuels and oxygen, and different types of flame. b. Apply Thermodynamics to solve the energy conversion of a combustion process. c. Apply Chemical Kinetics of Combustion to evaluate the chemical reaction of a combustion process. d. Evaluate the air pollutants formed and emitted during a combustion process. e. Understand the most current trend in combustion science with the main goal to protect the environment.
Subject Synopsis/ Indicative Syllabus	***Fundamentals of Combustion Science*** **-** nature of combustion; premixed and diffusion flames; laminar and turbulent flames; fuel-lean, stoichiometric and fuel-rich combustion; flame stability and flammable limits; open-flame and impingement heat transfer. ***Fuels and Combustion*** **-** gaseous, liquid and solid fuels; fuel properties; air pollutants formed during combustion process; alternative fuels. ***Thermodynamics of Combustion*** **-** combustion stoichiometry; chemical equilibrium and equations; Laws of Thermodynamics applying to combustion process; enthalpy of combustion; Adiabatic flame temperature; calorific value. ***Chemical Kinetics of Combustion*** **-** elementary reactions; chain and global reactions; nitrogen oxide kinetics; soot kinetics; dissociation and equilibrium constants. ***Combustion-led Air Pollution*** **-** carbon oxides and hydrocarbons; sulfur oxides; nitrogen oxides; particulates and soot. ***Current Trend in Combustion for Environmental Protection*** **-** sulfur-free liquid fuels; low-NO_X combustion; bio-fuels; hydrogen; hydrocarbon gaseous fuels enriched with hydrogen.

Teaching/Learning Methodology	Lectures are used to deliver fundamental knowledge in various scientific aspects of combustion. Seminars are provided by Guest Speakers on most current development in combustion science for the purpose of environmental protection. Tutorials are used to demonstrate the applications of fundamental knowledge of combustion science. Laboratory works are used to enhance the understanding of relationships among fuels, combustion processes and pollutant emissions, and provide hands-on experience for their evaluations.
Assessment Methods in Alignment with Intended Learning Outcomes	(see below)

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

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

Overall Assessment: 0.5 (Examination) + 0.5 (Continuous Assessment)
Continuous Assessment: Laboratory Report + Mini Project Report + Test

Laboratory report will be used to assess the students' understanding of relationships among fuels, combustion processes and pollutant emissions, and their ability to evaluate a combustion process.

Mini project report will be used to assess the students' understanding of relationships among fuels, combustion processes and pollutant emissions, and their ability to explore the most current development in combustion science.

Test and examination will be used to assess the students' overall understanding of the subject and their ability to apply fundamental knowledge at the middle and end of the semester.

Student Study Effort Expected	Class contact:	
	▪ Lectures and Seminars	33 Hrs.
	▪ Tutorials and Laboratory Works	6 Hrs.
	Other student study effort:	
	▪ Mini-project and Laboratory Reports	20 Hrs.
	▪ Assignments	20 Hrs.
	▪ Literature Review and Self-learning	33 Hrs.
	Student study effort expected	112 Hrs.

July 14

Subject Description Form

Subject Code	ME6601
Subject Title	Advanced Engineering Mathematics
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Prerequisite: Fundamental knowledge on vector and space, normed space, inner product, series, convergence etc.
Objectives	The subject aims at: 1. to equip students with fundamental concepts, definitions and theories of Banach spaces, Hilbert spaces, and their properties; 2. to introduce students with advanced knowledge of normed spaces, linear operators, and their applications to such as integral and differential equations
Intended Learning Outcomes	Upon satisfactory completion of the subject, students are expected to achieve the following outcomes: a. Understand Hilbert space and relating space concepts, and be able to illustrate them using examples in your research area; b. Use some vector theories/methods to solve a mathematical problem; c. Describe the main properties of the Hilbert space and understand the potential applications; d. Relate the knowledge of normed spaces and operators in Hilbert space to your research topics and apply them to integral and differential equations etc.
Subject Synopsis/ Indicative Syllabus	1. Normed vector spaces: Concepts, notations and methods in vector space theory; Vector spaces and properties; Normed spaces and basic theorems; Banach spaces and fundamental theory; Linear mappings and properties; Contraction mappings and the Banach fixed point theorem 2. The Lebesgue Integral: Step functions; Lebesque integrable functions; The space $L^1(R)$; The space $L^p(R)$ 3. Hilbert spaces and orthonormal systems: Inner product spaces; Hilbert spaces; Orthogonal and orthonormal systems; Projection theorem 4. Linear operators on Hilbert spaces: Bilinear functional and quadratic forms; Adjoint and self-adjoint operators; Invertible, normal, isometric and unitary operators; Positive, projection and compact operators; Eigenvalues and eigenvectors 5. Application issues (selective): Method of successive approximations; Ordinary differential equations and differential operators; or The Fourier transform
Teaching/Learning Methodology	This subject will be taught via lectures, tutorials, mini-projects and case studies. Tutorials, mini-projects and case studies will be conducted in small groups to facilitate discussions.

<table>
<tr><td rowspan="1">Assessment Methods in Alignment with Intended Learning Outcomes</td><td>

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Continuous Assessment	60%	√	√	√	√
2. Final	40%	√	√	√	
Total	100%				

</td></tr>
<tr><td>Student Study Effort Expected</td><td>

Class contact:	
▪ Lecture	39 Hrs.
Other student study effort:	
▪ Precepts or Tutorials	31 Hrs.
▪ After-class reading	34Hrs.
Student study effort expected	104 Hrs.

</td></tr>
<tr><td>Reading List and References</td><td>

1. Antosik, P., and Swartz, C., *Matrix Methods in Analysis*, Springer-Verlag, Berlin, latest edition.
2. Balakrishnan, A.V., *Applied Functional Analysis*, Springer-Verlag, New York, latest edition.
3. Herman J. Bierens, *Hilbert Space Theory and Its Applications to Semi-Nonparametric Modeling and Inference*, Pennsylvania State University, latest edition.
4. Lokenath Debnath, Piotr Mikusinski, *Introduction to Hilbert Spaces with Applications*, Elsevier Academic Press, latest edition.

</td></tr>
</table>

Revised July 16

Subject Description Form

Subject Code	ME6602
Subject Title	Computer Simulation Methods in Science and Engineering
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	N.A.
Objectives	1. To prepare the students to deal with the different perspectives and methodologies in scientific research using computer simulation; 2. To equip students with mathematics used in computer simulation methods; 3. To enable the students to apply computer-oriented simulation techniques and methods to solve modern science and engineering research problems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the numerical methods in solving ordinary differential equations and partial differential equations b. Understand the statistical simulation methods and how simulation is used in the modeling of stochastic processes c. Select and apply different simulation methods in the modelling of scientific problems in different time scales and length scales d. Understand the parallel computing methods in the modelling of large-scale systems
Subject Synopsis/ Indicative Syllabus	***Statistical Simulation Methods*** – Random numbers. Probability distributions and correlation functions. Stochastic equations. Brownian motions. Random walks. Statistical ensembles. Statistical calculation of physical quantities. Monte Carlo simulation. Lattice Boltzmann simulation. Examples of statistical simulations in thermodynamics, materials science, fluid mechanics and control. ***Atomistic Simulation Methods*** – Atoms and molecules. Inter-atomic potentials. Molecular dynamics simulation. Calculation of thermodynamic properties. Quantum effects. First-principles simulations. High-performance parallel computing. MPI. Computer clusters for very large scale atomistic simulation. ***Computational Fluid Dynamics (CFD)*** – Classification of partial differential equations, Navier-Stokes Equations, Grid generation, structured grid, unstructured grid. Turbulence and its modeling. ***Finite Difference Method for CFD*** - Finite difference formulations; parabolic partial differential equations, explicit method, implicit method, stability analysis; elliptic equations, solution algorithms; hyperbolic equations, explicit method, implicit method, splitting method. ***Other Numerical Methods*** - Finite Volume method for diffusion problems. Introduction to finite element method.

Teaching/Learning Methodology)	The subject will be taught via lectures and tutorials. Lectures are used to deliver the knowledge of computer simulation methods. Tutorials will be conducted in small groups to facilitate discussions.

Teaching/Learning Methodology	Outcomes					
	a	b	c	d		
Lectures	√	√	√	√		
Tutorials	√	√	√	√		

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	d		
1. Assignment	40%	√	√	√	√		
2. Test	10%	√	√	√	√		
3. Examination	50%	√	√	√	√		
Total	100%						

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

Assignments will be used to assess students' learning on the mathematics used in computer simulation methods, and on the principles and basic techniques of computer simulation methods.

Tests will be conducted to assess students' learning on fundamental knowledge of computer simulation methods.

Examination will be conducted to assess students' learning on the mathematics used in computer simulation methods, and on the principles of computer simulation methods.

Student Study Effort Expected

Class contact:	
▪ Lectures	33 Hrs.
▪ Tutorials	6 Hrs.
Other student study effort:	
▪ Performing assignments	40 Hrs.
▪ Private study	27 Hrs.
Total student study effort	106 Hrs.

Reading List and References	1. M. P. Allen, and D. J. Tildesley, Computer simulation of liquids, Oxford Science Publications, latest edition. 2. A. R. Leach, Molecular modelling: principles and applications, Prentice Hall, latest edition. 3. Harvey Gould, Jan Tobochnik, and Wolfgang Christian, An introduction to computer simulation methods: applications to physical systems, Addison-Wesley, latest edition. 4. K.A. Hoffmann and S.T. Chiang, Computational fluid dynamics for engineers, Engineering education system, latest edition. 5. H. K. Versteeg and W Malalasekera, An introduction to Computational Fluid Dynamics, Pearson Prentice Hall, latest edition.

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