THE HONG KONG POLYTECHNIC UNIVERSITY

Department of Mechanical Engineering

Doctor of Philosophy (PhD) /
Master of Philosophy (MPhil)

(Programme code: 43601)

Programme Booklet (2025/26)

Semester 1, 2025/26

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This Programme Booklet is subject to review and changes by the Department from time to time. Students will be informed of the changes as and when appropriate.

This document should be read together with the "Research Student Handbook" available at https://www.polyu.edu.hk/gs/rpghandbook/

Students admitted in Dual Award Programme or Joint PhD Supervision Programme should also read through the Appendix 1 (https://www.polyu.edu.hk/gs/rpghandbook/appendix1/) attached to the RPg Student Handbook.

Should any discrepancy between the contents of this booklet and University regulations arise, University regulations always prevail.

1. GENERAL INFORMATION

1.1 Programme Titles

Master of Philosophy (MPhil)

Doctor of Philosophy (PhD)

1.2 Offering Department

Department of Mechanical Engineering (ME)

1.3 Final Awards

Master of Philosophy (MPhil)

Doctor of Philosophy (PhD)

1.4 Period of Study and Mode of Attendance

(a) Normal Period of Study

Mode of Study	**MPhil** (Programme Code)	**PhD (**Programme Code)	
		For students with Master's degree containing a significant research component	**For students with a Bachelor's degree**
Full-time	2 Years (43601-FTM)	3 Years (43601-FD)	4 Years (43601-FTD)
Part-time	4 Years (43601-PTM)	6 Years (43601-PD)	8 Years (43601-PTD)

(b) Maximum Period of Study

Mode of Study	**MPhil** (Programme Code)	**PhD** (Programme Code)	
		For students with Master's degree containing a significant research component	**For students with a Bachelor's degree**
Full-time	3 Years (43601-FTM)	5 Years (43601-FD)	6 Years (43601-FTD)
Part-time	5 Years (43601-PTM)	7 Years (43601-PD)	9 Years (43601-PTD)

For Dual PhD students admitted from the 2018/19 cohort onwards

The duration of the normal period of study in PolyU is counted from the date the student registers at PolyU instead of that at the partner institution.

1.5 Entrance Requirements

(a) General Entrance Requirements

To register for a full-time/part-time MPhil Programme, an applicant shall normally hold a Bachelor's degree with Second Class Honours or above (or equivalent qualification) conferred by a recognised university;

To register for a 3-year full-time / 6-year part-time PhD Programme, an applicant shall normally hold an MPhil or equivalent (a research postgraduate degree with a dissertation as an award requirement) and a Bachelor's Degree conferred by a recognised university; and

To register for a 4-year full-time / 8-year part-time PhD Programme, an applicant shall normally hold:

- a Master's degree and a Bachelor's Degree conferred by a recognized university; or
- a Bachelor's degree with First Class Honours (or equivalent qualification), conferred by a recognised university.

In exceptional circumstances, applicants other than those stipulated above may be permitted to register. Such applicants may be required to pass an examination.

(b) English Language Requirements

The requirements for those Research Postgraduate (RPg) applicants who do not have a degree for which English was the language of instruction at a recognised university are:

- An overall score of at least 6.5 in the International English Language Testing System (IELTS) Academic Module; OR
- A Test of English as a Foreign Language (TOEFL) score of 80 or above for the Internet-based test.

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

2 RATIONALE, AIMS AND INTENDED LEARNING OUTCOMES OF THE PROGRAMME

2.1 University Overarching Aims of Research Degree Programmes

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

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

2.2 Leaning Outcomes for MPhil Programme of the Institution and Department of Mechanical Engineering (Revised)

Institutional Learning Outcomes	Intended Learning Outcomes of Individual Research Degree Programme
Socially responsible leaders with a strong sense of national pride and a global outlook MPhil graduates should demonstrate a critical awareness of current issues in local, national and global contexts, be able to deal with complex issues and make responsible decisions, and lead with integrity and pride for the benefit of society and a sustainable future.	**Socially Responsible Leaders** MPhil graduates in ME should be able to analyse current issues and make independent and responsible decisions.
Future-ready professionals who possess technical acumen MPhil graduates should be able to critically apply advanced discipline knowledge and scholastic skills in a broad range of professional contexts, make critical use of changing and emerging technologies for work, and deal with complex interdisciplinary issues. They should also be able to critically apply advanced knowledge in their expertise areas, perform research with minimal supervision, and make valuable contributions to the discovery of knowledge.	**Future-Ready Professionals** MPhil graduates in ME should be able to apply advanced knowledge and research skills to address evolving technological needs.

Institutional Learning Outcomes	Intended Learning Outcomes of Individual Research Degree Programme
Critical thinkers and creative problem solvers MPhil graduates should be able to critically evaluate complex information and arguments, make sound judgement in the absence of complete data, identify and analyse problems in complex situations and formulate creative strategic solutions. They should also be able to formulate individual research tasks and develop well- reasoned solutions.	**Critical Thinkers and Creative Problem Solvers** MPhil graduates in ME should be able to address engineering challenges and develop innovative solutions.
Effective communicators and collaborators MPhil graduates should be able to communicate effectively with a broad range of audiences, and foster effective and harmonious collaboration in an intercultural and/or interdisciplinary team.	**Effective Communicators and Collaborators** MPhil graduates in ME should be able to communicate engineering concepts with diverse audiences and foster collaboration in interdisciplinary teams.
Adaptable and resilient lifelong learners MPhil graduates should engage in continual professional development, reflect on their goals and purposes, refine their learning approaches, adapt to unfamiliar learning situations, and persevere through setbacks.	**Adaptable Lifelong Learners** MPhil graduates in ME should embrace lifelong learning, reflect on their experiences and adapt to new challenges.

2.3 Leaning Outcomes for PhD Programme of the Institution and Department of Mechanical Engineering (Revised)

Institutional Learning Outcomes	Intended Learning Outcomes of Individual Research Degree Programme
Socially responsible leaders with a strong sense of national pride and a global outlook PhD graduates should demonstrate foresight and originality in tackling emerging and unforeseen local, national and global challenges, be able to deal with highly complex issues and make responsible decisions, and lead with integrity and pride for the benefit of society and a sustainable future.	**Socially Responsible Leaders** PhD graduates in ME should be able to demonstrate foresight and innovation in addressing complex engineering challenges and be able to make independent and responsible decisions.
Future-ready professionals who possess technical acumen PhD graduates should be able to critically apply knowledge and skills at the forefront of an academic discipline and extend that knowledge through original research, anticipate future technology needs for professional practice, and deal with emerging complex interdisciplinary issues. They should also be well-versed in research skills and be able to critically apply in-depth knowledge in their expertise areas, perform independent research, and make significant and original contributions to the discovery and advancement of knowledge.	**Future-Ready Professionals** PhD graduates in ME should be able to apply advanced knowledge and research skills to address evolving technological needs.
Critical thinkers and creative problem solvers PhD graduates should be able to engage in critical inquiry of complex issues, make astute judgement in the absence of complete data, conceptualise problems in professional contexts and formulate sophisticated original solutions. They should also demonstrate robust logical thinking to identify and formulate original research problems and develop innovative solutions.	**Critical Thinkers and Creative Problem Solvers** PhD graduates in ME should be able to address complex engineering challenges and develop innovative solutions.

Institutional Learning Outcomes	Intended Learning Outcomes of Individual Research Degree Programme
Effective communicators and collaborators PhD graduates should be able to communicate complex ideas effectively to both specialist and non-specialist audiences, and establish and sustain interdisciplinary collaborations in academic/ professional endeavours.	**Effective Communicators and Collaborators** PhD graduates in ME should be able to communicate complex engineering concepts, conceptualize problems within professional contexts, and apply logical thinking to formulate research problems.
Adaptable and resilient lifelong learners PhD graduates should engage in an enduring quest for knowledge with a deep sense of purpose, critically reflect on their epistemic beliefs and learning approaches, adapt to new learning situations, and learn from failure.	**Adaptable Lifelong Learners** PhD graduates in ME should embrace lifelong learning, reflect on their experiences and adapt to new challenges.

3 PROGRAMME STRUCTURE

3.1 University Coursework, Language and National Education Requirements

Programme	Credit Requirements	Details
2-year full-time/ 4-year part-time MPhil	9 credits	1 credit from Academic Integrity and Ethics (AIE) + 2 credits from attending seminars + 6 credits from other subjects (no more than 3 credits from Guided-study subjects)
3-year full-time/ 6-year part-time PhD	15 credits	1 credit from Academic Integrity and Ethics (AIE) + 3 credits from attending seminars + 2 credits from Practicum + 9 credits from other subjects (no more than 6 credits from Guided-study subjects)
4-year full-time/ 8-year part-time PhD	22 credits	1 credit from Academic Integrity and Ethics (AIE) + 4 credits from attending seminars + 2 credits from Practicum + 15 credits from other subjects (no more than 9 credits from Guided-study subjects)

In addition to the above coursework/credit requirements, students are required to fulfil the English language proficiency and/or national education requirements, if applicable. Students admitted from the 2021/22 cohort onwards may be required to take additional credits (ranging from 0 to 5 credits) for the English enhancement subjects.

3.2 Academic Integrity and Ethics Requirement (AIE)

Academic Integrity and Ethics (AIE) are important so students should understand the subject matters as soon as possible.

All RPg students admitted in and after the 2024/25 cohort are required to pass a compulsory one-credit subject on AIE within their first study year. Students should report the AIE completion status in their first annual progress monitoring exercise. If students fail to pass the AIE subject by the given timeline, they would be considered making unsatisfactory progress which may lead to de-registration.

Students may choose one AIE subject from the subject pool via the link below: https://www.polyu.edu.hk/gs/rpghandbook/appendix2/ that best suits their research studies. The subject pool is subject to review and change.

3.3 Attendance at Seminar

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.

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.

The total credits to be earned by different categories of students will be:

2-year full-time/4-year part-time MPhil programmes: 2 credits
3-year full-time/6-year part-time PhD programmes: 3 credits
4-year full-time/8-year part-time PhD programmes: 4 credits

3.4 Practicum

All PhD students, irrespective of funding source and mode of study, must complete two training credits before thesis submission.

To earn one credit, students will be required to engage in teaching activities/professional service assigned by the Head of Department (HoD)/Dean of School (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 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 not allowed to fulfil part of their departmental training requirement through the completion of these compulsory training credits.

Students who are required to undertake teaching supporting activities are required to complete the training programmes organised by the Educational Development Centre, English Language Centre/Chinese Language Centre (as required) before the commencement of any teaching supporting activities.

3.5 Guided-study subjects

Guided-study subjects are those in which normally no lecturing is done and in which the student is required by the subject supervisor to read specified monographs and journal publications; the student and subject supervisor frequently meet to discuss the progress made by the student in the subject. The weighting assigned for coursework should be less than the weighting assigned for the examination. Coursework normally consists of assignments and presentations. Examination is compulsory and normally includes both written and oral. At the end of the semester, the student is examined by the subject supervisor and another staff member who is knowledgeable about the topic. A grade will be given in the same way as for regular taught subjects in Form GSB/27. All Guided-study subjects will be at level 6 and their code number will be between 6800 and 6999.

3.6 English Enhancement Subject Requirement

All English Enhancement Subjects (ELC6011, ELC6012 and ENGL6016) are credit-bearing.

All research students admitted from the 2021/22 cohort onwards are required to take the Research Language Skills Assessment (RLSA) in their first semester of MPhil/PhD study. Based on their performance of the RLSA, students will be assigned to complete zero to two English enhancement subjects (ranging from 0 to 5 credits) before thesis submission.

RPg students can refer to English Language Centre (ELC)'s webpage at Research Language Skills Assessment (RLSA).

3.7 National Education Requirement (Non-credit bearing subject)

All research students admitted from the 2022/23 cohort onwards are required to complete the National Education Requirement before thesis submission as a graduation requirement. Students are encouraged to complete the requirement as early as possible.

Details on the requirement are specified at:
https://www.polyu.edu.hk/ous/nationaleducation/en/curriculum/research-postgraduate-programme/

3.8 Programme Structure: Coursework credit and thesis requirements

3.8.1 Coursework credits of 2-year full time/4-year part-time MPhil

Mode and level	Subject (number of credits)	Compulsory/ Elective	Credit
MPhil 2-year Full-time/ 4-year Part-time	National Education Requirement (0)	Compulsory	0
	ENGL6016 Advanced Academic English for Research Students: Publishing and Presenting (3) ELC6011 Presentation Skills for Research Students (2) ELC6012 Thesis Writing for Research Students (3) * Subject to the Performance of RLSA	Compulsory	0/3/5*
	AIE Academic Integrity and Ethics (1)	Compulsory	1
	ME6001 Research Seminars I (1) ME6002 Research Seminars II (1)	Compulsory	2
	ME6602 Computer Simulation Methods in Science and Engineering (3) or ME6603 Advanced Mathematics of Physics and Modern Engineering (3)	Compulsory	3
	ME6101 Advanced Theory and Methods in Vibration Analysis (3) or ME6102 Advanced Topics in Control, Acoustics, and Dynamics (3) or ME6301 Properties, Applications and Modeling of Advanced Materials (3) or ME6302 Solid Mechanics (3) or ME6404 Advanced Thermofluids (3) or ME6405** Radiative Transfer: from Theory to Applications (3)	Compulsory	3
Total: 9 Credits + English Enhancement Subjects (if any)			

** Subject to approval by the University, the subject will be introduced in Semester 2, 2025/2026

3.8.2 Coursework credits of 3-year full-time/6-year part-time PhD

Mode and level	Subject (number of credits)	Compulsory/ Elective	Credit
PhD 3-year Full-time/ 6-year Part-time	National Education Requirement (0)	Compulsory	0
	ENGL6016 Advanced Academic English for Research Students: Publishing and Presenting (3) ELC6011 Presentation Skills for Research Students (2) ELC6012 Thesis Writing for Research Students (3) * Subject to the Performance of RLSA	Compulsory	0/3/5*
	AIE Academic Integrity and Ethics (1)	Compulsory	1
	ME6001 Research Seminars I (1) ME6002 Research Seminars II (1) ME6003 Research Seminars III (1)	Compulsory	3
	ME6006 Practicum I (1) ME6007 Practicum II (1)	Compulsory	2
	ME6602 Computer Simulation Methods in Science and Engineering (3); or ME6603 Advanced Mathematics of Physics and Modern Engineering (3)	Compulsory	3
	ME6101 Advanced Theory and Methods in Vibration Analysis (3); or ME6102 Advanced Topics in Control, Acoustics, and Dynamics (3); or ME6301 Properties, Applications and Modeling of Advanced Materials (3); or ME6302 Solid Mechanics (3); or ME6404 Advanced Thermofluids (3)	Compulsory	3
	ME6103 Intelligent Robotic Systems (3); or ME6403 Renewable Energy Technologies (3); or ME6405** Radiative Transfer: from Theory to Applications (3) or 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.	Elective	3
Total: 15 Credits + English Enhancement Subjects (if any)			

** Subject to approval by the University, the subject will be introduced in Semester 2, 2025/2026

3.8.3 Coursework credits of 4-year full-time/8-year part-time PhD

Mode and level	Subject (number of credits)	Compulsory/ Elective	Credit
PhD 4-year Full-time/ 8-year Part-time	National Education Requirement (0)	Compulsory	0
	ENGL6016 Advanced Academic English for Research Students: Publishing and Presenting (3) ELC6011 Presentation Skills for Research Students (2) ELC6012 Thesis Writing for Research Students (3) * Subject to the Performance of RLSA	Compulsory	0/3/5*
	AIE Academic Integrity and Ethics (1)	Compulsory	1
	ME6001 Research Seminars I (1) ME6002 Research Seminars II (1) ME6003 Research Seminars III (1) ME6004 Research Seminars IV (1)	Compulsory	4
	ME6006 Practicum I (1) ME6007 Practicum II (1)	Compulsory	2
	ME6602 Computer Simulation Methods in Science and Engineering (3); or ME6603 Advanced Mathematics of Physics and Modern Engineering (3)	Compulsory	3
	ME6101 Advanced Theory and Methods in Vibration Analysis (3); or ME6102 Advanced Topics in Control, Acoustics, and Dynamics (3); or ME6301 Properties, Applications and Modeling of Advanced Materials (3); or ME6302 Solid Mechanics (3);or ME6404 Advanced Thermofluids (3)	Compulsory	3
	ME6103 Intelligent Robotic Systems (3); or ME6403 Renewable Energy Technologies (3); or ME6405** Radiative Transfer: from Theory to Applications (3) or 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.	Elective	9
Total: 22 Credits + English Enhancement Subjects (if any)			

** Subject to approval by the University, the subject will be introduced in Semester 2, 2025/2026

3.9 Thesis Requirements

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

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

3.9.3 Students are required to complete the Coursework Credit Requirements, fulfil the English Language Proficiency and National Education Requirements before submission of their thesis for examination. All MPhil and PhD students need to complete their coursework with a qualifying GPA of 2.7 or above before submission of their thesis for examination.

The award will only proceed for ratification without any outstanding subject(s) remaining ungraded and unfinalised (including subject with Pass/Fail).

3.10 Relationship between the Programme Outcomes and Subjects

3.10.1 Doctor of Philosophy (PhD)

Programme Outcomes	Thesis	National Education Requirement	International Conference / Workshop attendance and presentation	Journal Paper Publications	Academic Integrity and Ethics	Research Seminar I - IV	Practicum I - II	Computer Simulation Method in Science & Engineering	Advanced Mathematics of Physics and Modern Engineering	Advanced Theory and Methods in Vibration Analysis	Advanced Topics in Control, Acoustics, and Dynamics	Properties, Applications and Modeling of Advanced Materials	Solid Mechanics	Advanced Thermofluids	Intelligent Robotic Systems	Renewable Energy Technologies	Radiative Transfer: from Theory to Applications	Free elective subjects offered within or outside PolyU, subject to the approval of the chief supervisor
	ME6001 — ME6004						ME6006 — ME6007	ME6602	ME6603	ME6101	ME6102	ME6301	ME6302	ME6404	ME6103	ME6403	ME6405	
To demonstrate foresight and innovation in addressing complex engineering challenges and be able to make independent and responsible decisions.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
To apply advanced knowledge and research skills to address evolving technological needs.	√		√	√	√	√		√	√	√	√	√	√	√	√	√	√	√
To address complex engineering challenges and develop innovative solutions.	√		√	√		√		√	√	√	√	√	√	√	√	√	√	√
To be able to communicate complex engineering concepts, conceptualize problems within professional contexts, and apply logical thinking to formulate research problems.	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	√
To be able to embrace lifelong learning, reflect on their experiences, and adapt to new challenges.	√		√	√	√	√	√											

3.10.2 Master of Philosophy (MPhil)

Programme Outcomes	Thesis	National Education Requirement	International Conference / Workshop attendance and presentation	Journal Paper Publications	Academic Integrity and Ethics	Research Seminar I - II	Computer Simulation Method in Science & Engineering	Advanced Mathematics of Physics and Modern Engineering	Advanced Theory and Methods in Vibration Analysis	Advanced Topics in Control, Acoustics, and Dynamics	Advanced Thermofluids	Properties, Applications and Modeling of Advanced Materials	Solid Mechanics	Radiative Transfer: from Theory to Applications
	AIE	ME6001 _ ME6004	ME6602	ME6603	ME6101	ME6102	ME6404	ME6301	ME6302	ME6405				
To be able to analyze current issues and make independent and responsible decisions.	√	√	√	√	√	√	√	√	√	√	√	√	√	√
To apply advanced knowledge and research skills to address evolving technological needs.	√		√	√	√	√	√	√	√	√	√	√	√	√
To address engineering challenges and develop innovative solutions.	√		√	√		√	√	√	√	√	√	√	√	√
To be able to communicate engineering concepts with diverse audiences and foster collaboration in interdisciplinary teams.	√		√	√		√	√	√	√	√	√	√	√	√
To be able to embrace lifelong learning, reflect on their experiences, and adapt to new challenges.	√		√	√	√	√								

4. REGULATIONS AND ADMINISTRATIVE PROCEDURES

The academic regulations governing the operation and assessment of all research degree programmes can be found in the "Research Student Handbook" available at https://www.polyu.edu.hk/gs/rpghandbook/. Some regulations are extracted and presented in the following sections.

4.1 Residence Requirement

4.1.1 Residence provides students with an opportunity to become immersed in the intellectual environment of the University. Also included in the residence are periods during which students' research requires off-campus field or non-PolyU laboratory work.

4.1.2 For students of regular RPg Programmes

The residence requirements are as follows:

Programme	Residence Requirement
2-year full-time/ 4-year part-time MPhil Programmes	2 regular semesters
3-year full-time / 6-year part-time PhD Programmes	3 regular semesters
4-year full-time / 8-year part-time PhD Programmes	4 regular semesters

Normally, the residence requirements in PolyU for Dual PhD and PolyU Joint PhD Supervision students from the 2022/23 cohort onwards are as follows:

For Dual PhD students

Programme	Residence Requirement
4-year full-time PhD Programmes	6 consecutive semesters/terms

For PolyU Joint PhD Supervision students

Programme	Residence Requirement
3-year full-time PhD Programmes	At least half of their normal study period
4-year full-time PhD Programmes	6 consecutive semesters/terms

The residence requirements may be different for individual Dual PhD and PolyU Joint PhD Supervision Programmes and students of other cohorts, subject to the prevailing agreements signed with the partner institutions. Please refer to the Research Postgraduate Student Handbook (https://www.polyu.edu.hk/gs/rpghandbook/) for details.

4.1.3 All students must fulfil the residence requirement before thesis submission.

4.1.4 In addition to the residence requirement, full-time students are required to be on campus full-time and consequently in such geographical proximity as to be able to participate fully in University activities associated with the programme.

4.1.5 Where a student needs to conduct his/her research outside Hong Kong, adequate supervision arrangements must be proposed by the Chief Supervisor and approved by the DoRPgS for study periods spent outside Hong Kong.

4.1.6 Leave taken by the students during their study at PolyU will be counted towards their residence requirement of PolyU.

4.2 Leave

4.2.1 With the prior agreement of the Chief Supervisor, a full-time student may take vacation leave of up to four weeks per study year.

4.2.2 Students' application for leave of absence shall be approved by the Chief Supervisor. All leave applications (except Unpaid leave) should be submitted with all relevant documents to the Leave Management System for approval and record.

4.2.3 RPg students should note that the granting of leave is not automatic. All applications should be made as far in advance as possible. Students will receive an email notification whether or not their applications have been approved after the leave application has been considered by the relevant approval authorities.

4.3 Confirmation of Registration

4.3.1 A successful applicant should first be registered provisionally for the degree of MPhil or PhD.

4.3.2 Students are required to have their registration confirmed, subject to a formal assessment, according to the normal deadlines as stipulated below:

Programme	Normal Deadline for Confirmation of Registration
2-year full-time MPhil Programme	At the end of the first 3 semesters/terms
3-year full-time PhD Programme	At the end of the first 5 semesters/terms
4-year full-time PhD Programme	At the end of the first 6 semesters/terms
4-year part-time MPhil Programme	At the end of the first 6 semesters/terms
6-year part-time PhD Programme	At the end of the first 9 semesters/terms
8-year part-time PhD Programme	At the end of the first 12 semesters/terms

4.3.3 Application for extension of confirmation of registration would only be considered on medical grounds. Medical proof must be attached to the application for the approval of the DoRPgS.

4.3.4 Students having their registration confirmed will be admitted to the candidacy for the MPhil or PhD degree. Students failing to have their registration confirmed by the deadline will be de-registered from the RPg Programme immediately.

4.3.5 Confirmation of Registration consists of

- Submission of a written report;
- A presentation to the Confirmation Panel and other attendees (as appropriate); and
- An oral defence of the research proposal.

4.4 GPA Requirement

4.4.1 All MPhil and PhD students need to complete their coursework with a qualifying GPA of 2.7 or above before submission of their thesis for examination. The award will only proceed for ratification without any outstanding subject(s) remaining ungraded and unfinalized (including subject with Pass/Fail).

4.4.2 The qualifying GPA (QGPA) is the result of the accumulated value of the subject grade point multiplied by the subject credit value divided by the total credit value for those subjects. It is computed as follows:

$$\text{Qualifying GPA} = \frac{\sum \text{Subject Grade Point x Subject Credit Value}}{\sum \text{Subject Credit Value}}$$

Where a) a. credits earned from all compulsory subjects and elective subjects (with the best grade points) will be included in the calculation of the qualifying GPA;

b) the following subjects will be excluded from the calculation of the qualifying GPA:
   (i) exempted subjects
   (ii) ungraded subjects
   (iii) incomplete subjects
   (iv) subjects taken after thesis submission
   (v) subjects assessed with a "Pass" or "Fail" grade
   (vi) subjects for which credit transfer has been approved, but without any grade assigned
   (vii) subjects from which a student has been allowed to withdraw (i.e., those with the grade "W").

4.4.3 Students may take more subjects than required in order to improve their GPA or in order to strengthen their knowledge.

4.4.4 Subjects taken after submission of the thesis will not contribute to the qualifying GPA.

4.4.5 Minimum number of credits with a letter grade

An MPhil student must complete at least three credits with a letter grade and a PhD student must complete at least six credits with a letter grade to allow for a meaningful calculation of the qualifying GPA.

4.5 Grading

All of the subjects taken will be assigned a grade.:

Grade	Grade Point	Description
A+	4.3	Excellent
A	4.0	
A-	3.7	
B+	3.3	Good
B	3.0	
B-	2.7	
C+	2.3	Satisfactory
C	2.0	
C-	1.7	
D+	1.3	Pass
D	1.0	
F	0	Failure

4.5.1 The grades obtained by research students on all subjects will be considered and endorsed by the Subject Assessment Review Panel (SARP) of the department offering the subject.

4.5.2 Unless specified otherwise, University's General Assessment Regulations (GAR) (available from Section C1 of https://www.polyu.edu.hk/ar/intranet/academic-regulations/har/) should also apply to the RPg programme.

4.6 Credit Transfer

4.6.1 Only credits gained from subjects at the postgraduate level with a passing mark/grade that have not been used to contribute to an award will be acceptable for transfer with the following exceptions:

(a) all returning students will be allowed to transfer the grade obtained in the Academic Integrity and Ethics (AIE) subject to the new RPg programme regardless of its level, provided that the grade was attained within the validity period (see para. 4.2.3). However, credit transfer will not be granted to returning students admitted in or after 2024/25 for the credit earned from the subject "HTI6081 Ethics: Research, Professional & Personal Perspectives";

(b) all 3-year full-time/6-year part-time PhD students will be allowed to transfer one credit from his/her previous attendance in seminars.

4.6.2 *Credit transfer of subjects at postgraduate level earned from recognised previous studies*

Applications for credit transfer from recognised previous studies will be endorsed by the D/SRC with justifications and approved by the HoD/DoS via Form GSB/33, with the following arrangements:

<table>
<tr><td rowspan="2"></td><td colspan="3">Credits previously taken</td></tr>
<tr><td>at PolyU</td><td>outside PolyU
(for regular PhD and PolyU Joint PhD Supervision students)
outside PolyU and the partner institution
(for Dual PhD students only)</td><td>at the partner institution
(for Dual PhD students only)</td></tr>
<tr><td>Validity period of credits</td><td colspan="3">eight years from the year of attainment at the time of admission</td></tr>
<tr><td>Maximum number of credits transferrable</td><td colspan="2">no more than 50% of the credit requirement of the RPg programme</td><td>No limit</td></tr>
<tr><td>Grade assignment</td><td>A grade shall be assigned</td><td>Only approval on the credit transfer is required. No grade shall be assigned.</td><td>A grade shall be assigned</td></tr>
</table>

4.6.3 *Credit transfer of subjects at postgraduate level taken outside PolyU after admission*

A student is allowed to take subjects outside PolyU during his/her studies at PolyU to gain credits if he/she obtains his/her Chief Supervisor's prior approval. Applications for credit transfer of such subjects, including those taken by Dual PhD students at the partner institution after admission, will be endorsed by the D/SRC with justifications and approved by the HoD/DoS via Form GSB/48. There is no limit on the number of credits to be approved for transfer. A grade shall be assigned.

4.6.4 The D/SRC shall assign an appropriate grade with due consideration to the academic equivalence of the subjects concerned and the comparability of the grading systems adopted by the University and the other institutions for the approval of the HoD/DoS.

For credit transfer of subjects assessed with a mark/score/grade, a letter grade shall be assigned in accordance with the grading table 4.5 above. However, if the equivalent subjects in the PolyU RPg programmes for claiming the credits transferred are originally assessed with a pass/fail grade (such as Seminars), only a "Pass" grade shall be assigned.

For credit transfer of subjects assessed with a pass/fail grade, a "Pass" grade shall be assigned, regardless of whether the equivalent subjects in the PolyU RPg programmes for claiming the credits transferred are originally assessed with a letter grade or not.

4.6.5 *Minimum number of credits with a letter grade*

Before applying for the credit transfer, student should observe the minimum number of credits with a letter grade (see para.4.4.5)

4.7 Deferment of Study

4.7.1 A student may apply within the normal period of study for deferment of up to 3 semesters/terms at a time, for no more than a cumulative total of 6 semesters/terms. Deferment will not count towards the period of study. Applications for deferment shall be approved by the D/SRC via the PolyU Chief Supervisor and the Chief Supervisor of the partner institution (for Dual PhD Programme) / Co-supervisor from partner institution (for PolyU Joint PhD Supervision Programme) (if applicable)

4.7.2 Deferment of study, if approved, is effective from the next semester.

4.7.3 Students approved for deferment of study before semester commencement will be entitled to a tuition fee refund. Application for deferment of study within a semester will only be considered before the start of the examination period.

4.7.4 Approval for deferment after the normal period of study shall not normally be considered except on the basis of certified health problem(s).

4.7.5 Resumption of study should start at the beginning of a semester.

4.7.6 Stipends will be stopped as soon as deferment commences. Students will be required to return the stipend overpaid during the deferment period to the university. Following the resumption of study, stipends, if provided, will only be paid from the day the semester commences or from the first day of the month.

4.8 Subject Registration

4.8.1 Research students will register for subjects at the same time as other students. Whether a research student can add a subject will depend on the availability of vacancies in the subject and the approval of the Chief Supervisor. A student should indicate his/her selected subject in Form GSB/26 for Chief Supervisor's approval before subject registration. Similarly, a student can drop a subject if it is approved by the Chief Supervisor. The student will effect the subject registration/deletion via eStudent.

4.8.2 After the add/drop period, further enrolment of subjects will normally not be entertained. Exceptional cases with good justification and to which the subject lecturer agrees will require the D/SRC's approval up to the end of the 4th week after the commencement of the semester.

4.9 Subject Withdrawal

4.9.1 Dropping of subjects after the add/drop period is not allowed. If a student has a genuine need to drop a subject after the add/drop period, it will be handled as subject withdrawal. The student should submit an application for subject withdrawal to the Chief Supervisor and Subject Lecturer for approval. The withdrawn subject will be reported in the Assessment Result Notification and Transcript of Studies although it will not be counted in the calculation of QGPA.

4.9.2 Application for subject withdrawal will not be entertained after the commencement of the examination period.

4.10 Subject Retaking

4.10.1 Students may only retake a subject which they have failed (i.e. Grade F or U). The number of retakes of a subject is restricted to two (i.e. a maximum of three attempts for each subject is allowed).

4.10.2 The second retake of a failed subject requires the approval of the Faculty/School Board Chairman.

4.10.3 Students who have failed a compulsory subject after two retakes and have been deregistered can submit an appeal to the Academic Appeals Committee (AAC) for a third chance of retaking the subject. If the AAC does not approve further retakes of a failed compulsory subject or the taking of an equivalent subject with special approval from the Faculty, the student concerned would be deregistered and the decision of the AAC shall be final within the University.

4.10.4 In cases where a student takes another subject to replace a failed elective subject, the fail grade will be taken into account in the calculation of the GPA, despite the passing of the replacement subject.

4.10.5 Departments/Schools may impose more stringent regulations on the retaking of particular types of subjects, e.g. practicum, clinical placement. Students should be duly informed.

4.11 Subject Exemption

A student may be exempted from taking a compulsory subject if s/he has successfully completed a similar subject previously in another programme or if s/he already has the associated knowledge/skills via work experience, etc. Subject exemption is decided by the DRC but students can also apply for it. In order to satisfy the credit requirement, it is necessary for the student to take another subject, to be approved by the Chief Supervisor, in place of the exempted subject. Such subject will be considered as an elective subject.

4.12 Study Progress

4.12.1 Students shall be required to submit progress reports as required from time to time by the University

4.12.2 The D/SRC shall, on receipt of the report, evaluate and assess the progress of the student. In the event that the student's progress is unsatisfactory, the D/SRC is required to give details of the proposed remedial action and consider carefully whether the student should be provided with stipend and/or cash awards for the following 12 months. The case, together with the D/SRC's recommendations, shall be submitted to the GSB Chair for decision. A student may be deregistered if his/her progress is rated unsatisfactory for two consecutive times.

4.12.3 If a student fails to submit his/her progress report by the end of the two-month grace period, the D/SRC shall convene a meeting (no decision by circulation) to consider whether the student should be de-registered as a result of his/her unsatisfactory progress. If deregistration is not recommended, the D/SRC shall forward the explanation in writing to the GSB Chair for consideration within one month of the expiry of the grace period

4.13 Deregistration

4.13.1 An RPg student will be de-registered from his/her studies at PolyU on grounds of academic failure in the following circumstances

a) if his/her progress is considered unsatisfactory; or
b) if he/she has reached the maximum number of retakes allowed for a failed compulsory subject (see Subject Retaking); or
c) if he/she fails to complete the Confirmation of Registration before the deadline; or
d) he/she fails to submit the thesis upon the expiry of the maximum period of study; or
e) if his/her thesis is deemed unsatisfactory.

4.13.2 A recommendation for deregistration as a result of unsatisfactory progress may be proposed by the Chief Supervisor and approved by the DRC. The DRC Chairman cannot take action by himself/herself on this issue.

4.13.3 A recommendation for deregistration made by the Board of Examiners (BoE) shall be approved or rejected by the GSB.

5. SUBJECT SYLLABI

The syllabi of subjects offered by Department of Mechanical Engineering are presented in the subsequent pages by alphabetical order of subject codes.

ME6001-4	Research Seminar I, II, III and IV ME6006-7 Practicum I and II
ME6101	Advanced Theory and Methods in Vibration Analysis
ME6102	Advanced Topics in control, Acoustics, and Dynamics
ME6103	Intelligent Robotic Systems
ME6301	Properties, Applications and Modeling of Advanced Materials
ME6302	Solid Mechanics
ME6403	Renewable Energy Technologies
ME6404	Advanced Thermofluids
ME6405**	Radiative Transfer: from Theory to Applications
ME6602	Computer Simulation Methods in Science and Engineering
ME6603	Advanced Mathematics of Physics and Modern Engineering

** Subject to approval by the University, the subject will be introduced in Semester 2, 2025/2026

Intended Blank

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, 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 **NOT** allowed to fulfil part of their departmental training requirement through the completion of these compulsory training credits. Students who are required to undertake teaching supporting activities~~,~~ are required to complete the training programmes organised by the Educational Development (EDC), English Language Centre/Chinese Language Centre (as required) 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.	

Revised Aug 2022

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

<table>
<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>1. Continuous Assessment</td><td>40%</td><td>√</td><td>√</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>2. Final</td><td>60%</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>

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture (13 weeks and 3 hrs per week)</td><td>39 Hrs.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Precepts or Tutorials</td><td>26 Hrs.</td></tr>
<tr><td>▪ After-class reading</td><td>39 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>104 Hrs.</td></tr>
</table>
</td></tr>
<tr><td>Reading List and References</td><td>1. Leonard Meirovitch, Fundamentals of Vibrations, McGraw Hill, latest edition.
2. Haym Benaroya, Mechanical vibration, Prentice Hall, latest edition.</td></tr>
</table>

Jan 15

Subject Description Form

Subject Code	ME6102
Subject Title	Advanced Topics in Control, Acoustics, and Dynamics
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To equip students with the knowledge of advanced control systems. 2. To equip students with the knowledge of advanced acoustics. 3. To equip students with the knowledge of advanced wave theory.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) Model the dynamic behaviour of mechanical systems and analyse their properties. b) Synthesise feedback control methods for automating various systems and machines. c) Model acoustic wave generation, propagation, reflection, scattering and absorption in various media. d) Apply the conceptual and theoretical acoustics knowledge to analyse acoustical problems. e) Apply the wave propagation theory to simulation, analyse and solve problems of wave propagation. f) Design non-destructive evaluation approaches using guided waves.
Subject Synopsis/ Indicative Syllabus	**Module 1. Automatic Control Systems**. • **Systems Modelling.** Discrete/continuous-time systems; Linear/non-linear systems; Energy-based dynamics (Lagrangian, Hamiltonian); Differential kinematic systems. • **Automatic Control Systems.** Feedback signals; Lyapunov stability; Optimal control; Passivity-based control; Model-based nonlinear control; Adaptive control systems; Sensor-based control; Servomechanisms; Multi-agent systems; Learning-based control. **Module 2. Advanced Acoustics** • **Acoustics.** Dynamics of fluid motion; Acoustic wave motion; Sound speed; Green's function; Acoustic modes; Sound transmission and absorption; Sound attenuation. • **Structural acoustics.** Vibration of continuous system; coupling between sound and vibration; Sound radiation; Sound transmission through a finite plate; Periodically supported systems. • **Numerical methods in acoustics.** Modal analysis; Finite element method; Computer simulations. **Module 3. Elastic Wave Propagation in Solids: Linear and Nonlinear Aspects**

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

- **Fundamental Theory.** Dispersion; Waves in layered plates and hollow cylinders; waves in viscoelastic medium.
- **Modelling Waves.** Analytical solutions; semi-analytical finite element method; modeling wave propagation.
- **Nonlinear Method.** Bulk waves in weakly nonlinear elastic medium; second harmonic generation; Weakly nonlinear wave equation.
- **Study Extension**. Phased array; imaging.

</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Lectures and Tutorials</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>e</td><td>f</td></tr>
<tr><td>1. Continuous Assessment</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Examination</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>
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 aims 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.
</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>33 Hrs.</td></tr>
<tr><td>▪ Tutorials/Case study</td><td>6 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Assignments</td><td>28 Hrs.</td></tr>
<tr><td>▪ Self-learning</td><td>39 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>106 Hrs.</td></tr>
</table>
</td></tr>
</table>

Reading List and References	1. Lecture Notes 2. Allan Pierce, Acoustics: an introduction to its physical principles and applications, Latest Edition 3. Jean-Jaques Slotine, Applied Nonlinear Control, First Edition 4. Philip Morse, Uno Ingard, Theoretical Acoustics, Latest Edition 5. Fabien Anselmet, Pierre-Olivier Mattei, Acoustics, Aeroacoustics and Vibrations, Latest Edition 6. Joseph Rose, Ultrasonic Guided Waves in Solid Media, Cambridge University Press, Latest Edition
Last Update	June 2024

Subject Description Form

Subject Code	ME6103
Subject Title	Intelligent Robotic Systems
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Prerequisite: Students should have basic knowledge of robotics and programming skills
Objectives	1. To provide students with both fundamental and advanced concepts and techniques for the design, modelling, analysis of robotic systems. 2. To provide students with the knowledge and state-of-the-art methods of intelligent robotic systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Formulate and solve robot kinematics of robotic systems. b. Apply advanced techniques for robotic systems. c. Apply the appropriate control strategy for robotic systems. d. Design or implement artificial intelligence solutions for robotic applications.
Subject Synopsis/ Indicative Syllabus	**Analytical fundamentals:** Coordinate transformations, forward and inverse kinematics, equations of motion, modelling of non-inertial systems, trajectory planning and navigation, kinematic constraints, multi-robot coordination, feedback control, interaction force control. **Advanced topics:** Under-actuated systems, redundancy resolution, medical and service robots, SLAM, machine learning and its applications for robotics.
Teaching/Learning Methodology	The teaching and learning methods include lectures, tutorials, homework assignment and project/experiments. Lectures aim at providing students with the fundamental and advanced knowledge required for understanding and analysing different robots, including system modelling, trajectory planning, control and artificial intelligence techniques. Tutorials aim at enhancing students' analytical and problem-solving skills on robotics. The project/experiment aims to have knowledge of computer simulations and hand-on experience on robot control.

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. Assignments	10%	√	√	√	√
2. Tests	20%	√	√	√	√
3. Projects	30%	√	√	√	√
4. Examination	40%	√	√	√	√
Total	100 %				

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

Overall Assessment:

0.40 x Examination + 0.6 x Continuous Assessment

The continuous assessment consists of three components: assignment (10%), tests (20%), and a team project (30%). They are aimed at assessing the understanding on modelling and analysis of robotic systems and its related technologies.

The examination will be use 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	33 Hrs.
▪ Tutorial/Laboratory	6 Hrs.
Other student study effort:	
▪ Reading and review	40 Hrs.
▪ Coursework (assignments, project)	30 Hrs.
Total student study effort	109 Hrs.

Reading List and References	1. S. B. Niku, Introduction to robotics: analysis, control, applications, Wiley, latest edition. 2. M. W. Spong S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control, Wiley, latest edition. 3. K. Lynch, Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press, latest edition. 4. B. Siciliano, L. Sciavicco, L. Villani, and G. Oriolo, Robotics, Modelling, Planning and Control, Springer, latest edition. 5. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Pearson, latest edition. 6. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, latest edition. 7. Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola, Dive into Deep Learning, Preview Version, latest edition. 8. Eli Stevens, Luca Antiga, Deep Learning with PyTorch, Manning Publications, latest edition.

Developed in December 2020.

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	ME6302
Subject Title	Solid Mechanics
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Prerequisite: Students should have basic knowledge in Calculus, Linear Algebra, Engineering Materials, and Mechanics of Materials.
Objectives	To provide students with knowledge of mathematical treatments of small and large deformation, constitutive relations, elasticity, plasticity, fracture mechanics.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the mathematical treatment of linear and non-linear mechanical behaviour of materials. b. Understand the broad applications of advanced theories in various engineering problems. c. Recognize the frontier of research in solid mechanics.
Subject Synopsis/ Indicative Syllabus	**Elasticity:** Stress and strain in 3D space and their tensor representations**,** theory for small deformation and large deformation, tensor analysis, viscoelasticity, rubber elasticity, contact mechanics, micromechanics. **Plasticity:** Yield criteria, Convexity of yield surface and the associated flow rule, Bauschinger effect and back stress, Incremental theories of plasticity, Slip-Line Field Solutions, Crystal plasticity. **Fracture Mechanics:** Stress intensity factor K, Energy release rate**,** Griffith theory, criterion for brittle materials, J-Integral. **Finite element modelling**: Constitutive models and user subroutine, Implicit and Explicit methods.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures, laboratory sessions, homework assignments, test, mini-project, and examination.
2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for advanced topics in solid mechanics.
3. Technical/practical examples and problems are raised and discussed in class.
4. The mini project could be a numerical simulation project or literature survey on a given topic.

Teaching/Learning Methodology	Intended Subject Learning Outcomes		
	a	b	c
1. Lecture	√	√	√
2. Homework assignment	√	√	
3. Mini-project	√	√	√

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. Mini-project	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, mini-project report & presentation. They are aimed at evaluating the progress of 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	39 Hrs.
	Other student study effort:	
	• Self-study	39 Hrs.
	• Mini-project	28 Hrs.
	Total student study effort	106 Hrs.
Reading List and References	1. YC Fung, *Foundations of solid mechanics*, latest edition, Prentice Hall 2. JD Ferry, *Viscoelastic Properties of Polymers*, latest edition, Wiley 3. R Hill, *The Mathematical Theory of Plasticity*, Clarendon Press 4. TL Anderson, *Fracture Mechanics, Fundamentals and Applications*, latest edition, Taylor & Francis, CRC Press *5.* S Nemat-Nasser M Hori, *Micromechanics: Overall Properties of Heterogeneous Materials*, North-Holland 6. K.L. Johnson, *Contact Mechanics*, Cambridge University Press	

(Implemented from 2019/20 academic year.)

March 2019

Subject Description Form

Subject Code	ME6403
Subject Title	Renewable Energy Technologies
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To understand the importance of renewable energy in solving the energy and environmental problems we are facing. 2. To provide students with fundamental knowledge of renewable energy conversion, storage and utilization technologies. 3. To enable students to design and analyze major renewable energy application systems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) understand the concepts and components of renewable energy systems; b) apply the fundamental knowledge of renewable energy systems for applications and innovations; c) design and evaluate major renewable energy systems; d) obtain comprehensive knowledge and skills on selected topics in renewable energy systems.
Subject Synopsis/ Indicative Syllabus	***Introduction***: renewable energy resources, renewable energy use and environment, climate change. ***Energy Conversion:*** solar energy (resource, photovoltaic and concentrated solar power); wind energy (resource, wind turbine); geothermal energy (resource, power generation); biomass conversion; hydrogen and fuel cells; artificial photosynthesis (photo/electrochemical carbon dioxide and nitrogen reduction); nuclear energy. ***Energy Storage:*** portable energy storage (lithium-ion batteries); large-scale energy storage (flow batteries); energy storage in chemicals; site dependent energy storage (compressed air and pumped hydro). ***Energy Utilization:*** efficient usage of energy in industries and buildings; energy saving; pinch analysis.
Teaching/Learning Methodology	The realization of the intended learning outcomes will be primarily on the basis of lectures under adequate guidance from subject instructors. Students will also be directed to complete a team project with report and presentation to enhance understanding of the subject contents and practice presentation skills.

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. Homework	20%	✓	✓	✓	
2. Project	30%				✓
3. 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 (30%) and homework (20%). The team project and homework are aimed at evaluating their understandings on renewable energy 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	33 Hrs.
▪ Project	6 Hrs.
Other student study effort:	
▪ Self-learning	66 Hrs.
Total student study effort	105 Hrs.

Reading List and References	J.A. Duffie, W.A. Beckman, Solar Engineering of Thermal Processes, Photovoltaics and Wind, 5th Edition, Wiley, Latest Edition. (Available in our library) A.V. da Rosa, J.C. Ordonez, Fundamentals of Renewable Energy Processes, 4th Edition, Elsevier Science, Latest Edition. (Earlier version is available in our library) A.L. Dicks, D.A.J. Rand, Fuel Cell Systems Explained, Wiley, Latest Edition. (Available in our library) J. Newman, K.E. Thomas-Alyea, Electrochemical Systems, Wiley, Latest Edition. (Available in our library) R. Korthauer, Lithium-Ion Batteries: Basics and Applications, Springer, Latest Edition. (Available in our library)

Developed in December 2020.

Subject Description Form

Subject Code	ME6404
Subject Title	Advanced Thermofluids
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To provide both fundamental and advanced concepts and methods in thermofluids. 2. To introduce the state-of-the-art advances in thermofluids.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Formulate and solve thermofluid problems by applying fundamental principles. b. Keep pace with the time on the advances in thermodynamics, fluid mechanics and heat transfer. c. Communicate effectively through completing written reports and oral presentation. d. Conduct a comprehensive survey on selected topics in thermofluids through completing a project.
Subject Synopsis/ Indicative Syllabus	***Thermodynamics*** – Re-examination of classical thermodynamics; nature of thermodynamics, further development directions; basic concepts; Carnot principles; temperature; Clausius inequality; entropy; fundamental laws; logical reasoning approaches. ***Fluid Mechanics*** – Newtonian and non-Newtonian fluids; continuity and momentum equations; differential analysis of fluid flow; Coutte flow; fluid film; Poiseuille flow; dimensional analysis; boundary layer equations; closure problem; turbulence modeling; fundamental constraints; invariance; realizability; principle of material frame indifference; physics-preserving models; linear and quadratic models. ***Heat Transfer*** – Heat flux; conduction and convection; general analytical approach for heat conduction problems; general empirical approach for convection problems; constitutive relations; fundamental laws; generalized Fourier law; decomposition theorem of motion; linear theory of heat flux; overall heat transfer coefficient; LMTD method; effectiveness – NTU method.
Teaching/Learning Methodology	Lectures are used to deliver the fundamental and advanced knowledge of thermofluids. Tutorials are used to illustrate the applications of thermofluids knowledge. A project is designed to have students learn how to collect, analyze and summarize up-to-date research information on selected topics in thermofluids.

<table>
<tr>
<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
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<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="4">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></tr>
<tr><td>1. Project Report / Presentation</td><td>50%</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Assignment</td><td>20%</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>2. Examination</td><td>30%</td><td>√</td><td>√</td><td></td><td></td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="4"></td></tr>
</table>

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

Overall Assessment: 0.7 (Continuous Assessment) + 0.3 (Examination)
Continuous Assessment: Project Report + Project Presentation + Assignment

Examination is adopted to assess students on the overall understanding and the ability of applying fundamental concepts and principles. It is supplemented by the project report, presentation and assignment, which provide timely feedback to both lecturers and students on various topics in the syllabus.
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<tr>
<td>Student Study Effort Expected</td>
<td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lectures</td><td>33 Hrs.</td></tr>
<tr><td>▪ Tutorials</td><td>6 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Project (reports and presentation)</td><td>45 Hrs.</td></tr>
<tr><td>▪ Self-learning</td><td>40 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>124 Hrs.</td></tr>
</table>
</td>
</tr>
<tr>
<td>Reading List and References</td>
<td>

Cengel Y. A. and Boles M. A., Thermodynamics: An Engineering Approach, McGraw-Hill, latest edition.
Cengel Y. A. and Cimbala J. M., Fluid Mechanics: Fundamentals and Applications, McGraw-Hill, latest edition.
Holman J. P., Heat Transfer, McGraw-Hill, latest edition.
Publications in Nature, Science and Cell journals on thermodynamics, fluid mechanics, heat and mass transfer, and related topics.

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</table>

March 2024

Subject Description Form

Subject Code	ME6405
Subject Title	Radiative Transfer: from Theory to Applications
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To understand the importance of radiative transfer processes in energy-related applications. 2. To provide fundamental knowledge of radiative transfer concepts. 3. To enable the formulation and solution of radiative transfer problems using computational tools. 4. To equip students with the computational skills (e.g. Python programming) to design and analyze energy systems involving radiative transfer.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the principles and applications of radiative transfer in energy systems. b. Apply fundamental knowledge of radiative transfer to model and analyze energy systems. c. Design and evaluate energy systems that incorporate radiative transfer principles. d. Develop computational skills to solve complex radiative transfer problems.
Subject Synopsis/ Indicative Syllabus	***Introduction:*** review of basic heat transfer principles: conduction, convection, and radiation; examples of radiative transfer in engineered energy systems and the Earth-atmosphere system. ***Radiative transfer between surfaces:*** the electromagnetic spectrum; spectral and directional characteristics of surface radiation; black and gray surfaces; view/shape factors; radiative exchange between black and gray surfaces. ***Radiative transfer in participating medium:*** the equation of transfer; gas radiation properties; radiation exchange between gas and enclosure; radiation transmission in glazing and other materials; Monte Carlo method for direct radiative transfer modelling. ***Atmospheric radiation:*** atmosphere composition and plane-parallel atmosphere; emission and absorption by gases; the HITRAN database; scattering by gases and particles (aerosols and clouds); atmospheric longwave radiation transfer; atmospheric shortwave (solar) radiation transfer. ***Case study:*** radiative transfer in combustion chambers; radiative transfer in water bodies; radiative transfer in solar systems, including photovoltaic systems, concentrated and flat plate solar thermal systems; principles of radiative cooling systems.

Teaching/Learning Methodology

The realization of the intended learning outcomes will be primarily based on lectures under adequate guidance from subject instructors. Tutorials on computational tools and projects will be integrated into the lecture sessions.

Students will also be directed to complete a team project with report and presentation to enhance understanding of the subject contents and practice presentation skills.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	✓	✓		
Tutorial		✓	✓	✓
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
1. Assignment	30	✓	✓	✓	✓
2. Project	30	✓	✓	✓	✓
3. Examination	40	✓	✓		
Total	100 %				

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

Overall Assessment:

0.40 × Examination + 0.60 × Continuous Assessment

1. The continuous assessment will comprise two components: team project (30%) and individual assignment (30%). The team project and homework are aimed at evaluating their understandings on the physical principles, formulating and solving related problems and enhancing the computational skills.

2. The examination (40%) 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 and tutorials	36 Hrs.
▪ Project presentation	3 Hrs.
Other student study effort:	
▪ Self-learning	36 Hrs.
▪ Assignments and projects	50 Hrs.
Total student study effort	125 Hrs.

Reading List and References	1. A.F. Mills, C. F. M. Coimbra, Heat Transfer 3rd Edition, Temporal Publishing, 2016. 2. J.A. Duffie, W.A. Beckman, Solar Engineering of Thermal Processes, Photovoltaics and Wind, 5th Edition, Wiley, 2020. 3. G.W. Petty, A First Course in Atmospheric Radiation, 2nd Edition, Sundog Publishing, 2006. 4. O.N. Vassiliev, Monte Carlo Methods for Radiation Transport: Fundamentals and Advanced Topics, Springer Nature, 2017.

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 provide students with different simulation related methodologies in scientific research from different disciplines; 2. To equip students with numerical method technologies to support computer simulation and its realization; 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. Use the numerical methods in solving ordinary differential equations and partial differential equations b. Understand the numerical simulation methods and how simulation is used in the modeling of engineering processes c. Select and apply different simulation methods in modelling of scientific problems in different size scales d. Apply simulation methods to solve practical scientific and engineering problems and provide feasible solutions.
Subject Synopsis/ Indicative Syllabus	***Simulation Methods and fundamentals –*** 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, other simulation methods, Case studies and examples. ***Finite element method –*** Finite element formulation for elastic deformation. Finite element for plastic and visco-plastic deformation. Shape function. Element type and isoparametric element, Numerical integration. Selection of mesh and discretization. Case studies and examples. ***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 –*** 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. ***Applications of Numerical Simulation –*** Product strength design. Manufacturing process simulation and optimization. Product fatigue life design and analysis. Product damage and fracture analysis and prediction

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	27 Hrs.
▪ Tutorials	12 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. 6. MW FU, Design and Development of Metal Forming Processes and Products aided by Finite Element Simulation, Springer International Publishing AG, 2016

Revised August 2020

Subject Description Form

Subject Code	ME6603
Subject Title	Advanced Mathematics of Physics and Modern Engineering
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	Prerequisite: Fundamental knowledge on single-variable and multi-variable calculus.
Objectives	The subject aims at: 1. To equip students with advanced concepts, definitions and theories of linear algebra and matrices, complex analysis and transformations, ODEs and PDEs. 2. To introduce students with advanced knowledge of engineering mathematics to various classical problems in mechanical engineering.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students are expected to achieve the following outcomes: a. Understand and relating concepts of linear algebra and matrices, and be able to illustrate them using examples in their research area. b. Use the taught theories/methods to solve ODEs and PDEs from mathematical physics. c. Describe the main properties of the analytic functions and transformation methods and understand their potential applications. d. Relate the knowledge of advanced engineering mathematics to their research topics.
Subject Synopsis/ Indicative Syllabus	1. **Linear algebra and matrices:** (a) Finite dimensional transformation and matrix representations: rank, null space, inner products, adjoints, determinants, Ax=b. (b) Eigen-problems Av=λv: similarity transforamtions, diagonalization and Jordan forms. (c) Symmetric, Hermitian, orthogonal and unitary matrices; spectral decomposition. (d) Schur's therom, Gershgorin's theorem, singular value and L-U decomposition. 2. **ODEs:** (a) ODE theory: existence, uniqueness, dependence on initial data. (b) Initial value problems for linear ODEs, fundamental solution matrices and matrix exponentials; non-linear ODEs and linearization. (c) Bounary value problems, Green's functions for ODEs. (d) Green's functions for PDE boundary value problems, Posson's equation. 3. **Complex variables:** (a) Elementary functions, analytic functions, linear integrals and Cauchy's integral formula, Taylor and Laurent series, singularities and residues, Cauchy's residue theorem and contour ingerations. (b) Conformal mapping. 4. **PDEs:** (a) Linear, quasilinear and nonlinear PDE; classifications of 2nd order linear PDE: hyperbolic, parabolic and elliptic equations. (b) Methods

<table>
<tr><td></td><td>of solutions: separation of variables, Fourier and Laplace transform methods, travelling waves.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>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.</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="4">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></tr>
<tr><td>1. Continuous Assessment</td><td>60%</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>2. Examination</td><td>40%</td><td>√</td><td>√</td><td>√</td><td></td></tr>
<tr><td>Total</td><td>100%</td><td colspan="4"></td></tr>
</table>

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

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, closed-book tests and projects. The continuous assessment is aimed at enhancing the students' comprehension and assimilation of various topics of the syllabus. Continuous assessment will also be used to assess the students' capacities of self-learning and problem-solving and effective communication skill in English so as to fulfil the requirements of being a qualified PhD student.</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>• Lecture</td><td>39 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Precepts or Tutorials</td><td>32 Hrs.</td></tr>
<tr><td>▪ After-class reading</td><td>34 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>105 Hrs.</td></tr>
</table>
</td></tr>
</table>

Reading List and References	1. D. A. McQuarrie, Mathematics Methods for Scientists and Engineers, University Science Books, latest edition. 2. M. Greenberg, Foundations of Applied Mathematics, Pretice Hall, latest edition. 3. R. A. Horn and C. R. Johnson, Matrix Analysis, Cambridge University Press, latest edition. 4. F. B. Hildebrand, Advanced Calculus for Applications, Prentice Hall, latest edition. 5. I. S. Sokolnikoff and R. M. Redheffer, Mathematics of Physics and Modern Engineering, McGraw Hill, latest edition.
Last Updated	July 2023