THE HONG KONG POLYTECHNIC UNIVERSITY

DEPARTMENT OF APPLIED MATHEMATICS

PROGRAMME DOCUMENT FOR RESEARCH DEGREES

Master of Philosophy

Doctor of Philosophy

2020

General Information

Institution	:	The Hong Kong Polytechnic University
Faculty	:	Faculty of Applied Science and Textiles
Department	:	Department of Applied Mathematics
Head	:	Professor Defeng SUN
Programme	:	Research Postgraduate Programme in Applied Mathematics
Mode of Attendance	:	Full time and Part time
Duration (Normal study period)	:	M.Phil 24 months for full-time, 48 months for part-time. 3- year PhD 36 months for full-time, 72 months for part-time. 4- year PhD 48 months for full-time, 96 months for part-time. (for admission with Bachelor Degree or Master Degree without any research components)
Implementation Date	:	September 2014
Programme Leader	:	Dr. Zhian WANG

The document is applicable to students admitted to the Research postgraduate programme in Applied Mathematics from academic year 2015/2016 onwards.

This Programme Document is subject to review and changes which AMA can decide to make from time to time. Students will be informed of the changes as and when appropriate.

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

1 Full ProgrammeTitles

Mater of Philosophy (MPhil)
Doctor of Philosophy (PhD)

2 Host Department(s)

Department of Applied Mathematics
應 用 數 學 系

3 Awards

1. M.Phil.
2. PhD

4 Medium of Instruction

All subjects are taught in English, unless otherwise specified.

5 Normal Duration and Mode of Attendance

M.Phil
24 months for full-time, 48 months for part-time.

3- year PhD
36 months for full-time, 72 months for part-time.

4- year PhD
(for admission with Bachelor Degree or Master Degree without any research components)
48 months for full-time, 96 months for part-time.

6 Mode of Attendance

- Full-time
- Part-time

7 Programme Management

Programme Leader
The Programme Leader will provide the academic and organizational leadership for the programme. The Programme Leader should expect the full support and cooperation of the Head of Department and Heads of other contributing Departments but should recognise that a Head will have to balance a range of departmental demands and priorities in allocating

staff and resources to the programme. In particular, a Programme Leader's responsibilities are:

(i) to ensure the effective conduct and organization of the programme within agreed policies and regulations;
(ii) to negotiate with the Head(s) of Department(s) about the allocation of appropriate staff for supervision and other duties required by the programme;
(iii) to develop good working relationships with the Heads and relevant senior staff of Departments involved in the programme and with staff for supervision on the programme;
(iv) to keep in close touch with the academic welfare and progress of students on the programme, and to be closely aware of students' views about the programme;
(v) to report to the Heads of Departments concerned on the on-going requirements of staff and resources for the programme, as part of the preparation of departmental estimates;
(vi) to lead the development of the programme and the implementation of the Programme Learning Outcomes Assessment Plan;
(vii) to coordinate the inputs to and the debate of the Departmental Programme Committee leading to the annual programme review reports (including the programme learning outcomes assessment results) which form part of the Annual QA Report and Business Plan, and other periodic programme reviews; and
(viii) to take executive action as agreed by the Departmental Programme Committee.

8 Entrance Requirements

Applicants seeking admission to a research postgraduate programme should satisfy the following minimum entrance requirements:

MPhil: a Bachelor's degree in a relevant area with first or second class honours from The Hong Kong Polytechnic University or from another recognised university; or other academic qualifications which are deemed to be equivalent.

PhD: a postgraduate degree in a relevant area containing a significant research component, such as a dissertation, conferred by The Hong Kong Polytechnic University or another recognised university. In exceptional circumstances, students with a Bachelor's degree with First Class Honours, or the equivalent, may be admitted directly to the PhD programme. Such applicants may be required to pass an examination.

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

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

1. an overall score of at least 6.5 in the International English Language Testing System (IELTS); or
2. a Test of English as a Foreign Language (TOEFL) score of 80 or above for the Internet-based test or 550 or above for the paper-based test.

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

9 Programme Learning Outcomes

Programme Aims

The aim of the programme is to enable the students to acquire competence in research methods and scholarship in Applied Mathematics, and to display sustained independent effort and independent original thought. This programme prepares students to become academics, researchers or industrial R & D professionals upon graduation.

Programme Outcomes

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

- develop and demonstrate research skills and knowledge in applied mathematics; critically analyze new and complex information from real problems, and effectively utilize research methodologies in applied mathematics; and
- recognize the importance of research ethics; and
- provide novel solutions to research problems and effectively interpret new research results; and
- learn up-to-date research advances and developments in applied mathematics; and
- present results with good scientific writing and presentation skills (for PhD programme)

10 The Curriculum

Course/ Credit Requirement

Students are mainly conducting research study under the supervision of their main supervisor's guidance. Different categories of students need to attain different credit requirements. The credit requirements should cover attending seminars and Practicum as follows:

2-year MPhil: 9 credits
(1 credit from HTI6081 + 2 credits from attending seminars (AMA67711+AMA67712) +AMA613+ 3 credits from other subjects)

3-year PhD: 15 credits
(1 credit from HTI6081 + 3 credits from attending seminars (AMA67711+AMA67712+AMA67713) + 2 credits from Practicum *(AMA67721+AMA67722) + AMA613+ 6 credits from other subjects)*

4-year PhD: 22 credits
(1 credit from HTI6081 + 4 credits from attending seminars (AMA67711+AMA67712+AMA67713+AMA67714) + 2 credits from Practicum *(AMA67721+AMA67722) + AMA613+12 credits from other subjects)*

Other subjects can be chosen from the research postgraduate subject list offered by AMA, other PolyU departments or other local Universities with a similar level.

List of the subjects offered by the department are varied from year to year.

Attendance in research seminars/ workshops/ conferences

Full-time students are required to attend at least 10 research seminars per year (of which at least 8 research seminars must be within AMA), 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 (of which at least 8 research seminars must be within AMA), 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.

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.

Practicum

As part of the programme requirement, 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 or his/her delegate for 6 hours/week in any 13-week semester.

Students are allowed to complete these two credits any time before they graduate. They can choose to complete these two credits in two different semesters or within the same semester, subject to the approval of the Chief Supervisor. Stipend recipients are allowed to fulfill part of their departmental training requirement through the completion of these compulsory training credits.

The HoD or his/her delegate is required to:
a. ensure that the activities are structured and can be assessed properly;
b. submit, 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.

In addition to the 2 credits requirement, the department would also assign students to mark assignments and invigilate mid-term tests and examinations in every semester. Students are also expected to help in conferences organized by the department.

Guided Study Subjects

The maximum number of credits to be taken is 3.

Language Proficiency Requirement after Admission

With effect from 2018/19 cohort onwards, all RPg students shall be required to take two English enhancement subjects, namely ELC6001 "Presentation Skills for Research Students" and ELC6002 "Thesis Writing for Research Students". For exemption, RPg students need to pass the Research Language Skills Assessment (RLSA).

Before thesis submission, students are required to take and pass the English enhancement subjects.

Thesis requirements

Option 1: A thesis must be submitted to the satisfaction of the supervisor(s) for reviews by external examiners. The submitted thesis must contain at least one accepted/published paper in an SCI journal for PhD students.

Option 2: A PhD thesis must be submitted to the satisfaction of the supervisor(s) for reviews by external examiners. Prior to submission for reviews by external examiners, a PhD thesis which does not contain any accepted/published paper in a good journal must pass a review conducted by AMA PhD Thesis Assessment Committee. The AMA PhD Thesis Assessment Committee should consist of the Programme Leader (Panel Chair) and two independent members from different research groups.

Graduation Requirements

A student would be eligible for award if he/she satisfies all the conditions listed below:

(i) Accumulation of the requisite number of credits for the particular award, as defined in the definitive programme document; and
(ii) Satisfying all other requirements as defined in the definitive programme document and as specified by the University; and
(iii) 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.
(iv) Take and pass an oral defense of his/her thesis
(v) All other general University requirements relating to Graduation Requirements.

11 Subjects Support to Programme Outcomes

Grading

Assessment grades shall be awarded on a criterion-referenced basis. A student's overall performance in a subject shall be graded as follows with effect from the 2020/21 academic year for all students,:

Subject grade	***Short description***
A+	Excellent
A	
A-	
B+	Good

Subject grade	*Short description*
B	
B-	
C+	Satisfactory
C	
C-	
D+	Pass
D	
F	Failure

'F' is a subject failure grade, whilst all others ('D' to 'A+') are subject passing grades. No credit will be earned if a subject is failed.

A numeral grade point is assigned to each subject grade, as follows:

Grade	New Grade Point
A+	4.3
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
D+	1.3
D	1.0
F	0.0

The qualifying Grade Point Average (GPA) will be computed as follows, and based on the grade point of all the subjects:

$$\text{GPA} = \frac{\sum_{n} \text{Subject Grade Point} \times \text{Subject Credit Value}}{\sum_{n} \text{Subject Credit Value}}$$

where n = number of all subjects (inclusive of failed subjects) taken by the student up to and including the latest semester/term, but for subjects which have been retaken, only the grade obtained in the final attempt will be included in the GPA calculation

12 The Curriculum Map

Programme Outcomes	AMA610	AMA611	AMA612	AMA613	AMA614	AMA615	AMA616	AMA6881	AMA6882	AMA6883	AMA6884	AMA6885	AMA6886	AMA6887	HTI 6081	ELC6001	ELC6002	Attend seminars	Dept. training	Thesis
a. To develop and demonstrate research skills and knowledge in applied mathematics; critically analyze new and complex information from real problems, and effectively utilize research methodologies in applied mathematics	√	√	√	√	√	√	√	√	√	√	√	√	√	√						√
b. To present results with good scientific writing and presentation skills				√				√	√	√	√	√	√	√		√				√
c. To recognize the importance of research ethics															√					√
d. To provide novel solutions to research problems and effectively interpret new research results																				√
e. To learn up-to-date research advances and developments in applied mathematics								√	√	√	√	√	√	√				√	√	√
f. To demonstrate effective writing skills and publish high-quality research articles				√				√	√	√	√	√	√	√			√			√

SUBJECT DESCRIPTIONS

(AMA SUBJECTS)

arranged in alphabetical order

Master of Philosophy
Doctor of Philosophy

Key: C = Compulsory CA = Continuous Assessment E =Elective EXAM= Examination

Code	Subject Title	C/E	Credit	Assessment CA : EXAM (%)	Pre-requisite (P)/ Expected background knowledge
AMA610	Advanced probability theory	E	3	40 : 60	A course in Probability Theory and a course in Advanced Calculus
AMA611	Applied Analysis	E	3	50 : 50	A course in Linear Algebra and a course in Advanced Calculus. A course in Partial Differential Equations or Analysis would be highly recommended.
AMA612	Numerical methods for Partial Differential Equations	E	3	40 : 60	A course in Differential Equations and a course in Advanced Calculus
AMA613	Mathematics Seminar	C	3	100 : 0	A compulsory subject for research students of AMA enrolled for at least six months
AMA614	Mathematical Statistics	E	3	40 : 60	A course in Probability and Statistics and a course in Advanced Calculus
AMA615	Nonlinear Optimization Methods	E	3	40 : 60	A course in Linear Algebra and a course in Advanced Calculus
AMA616	Statistics for Finance	E	3	40 : 60	A course in Statistical Analysis and a course in Advanced Calculus
AMA6881	Guided Study in Applied Optimization	E	3	100 : 0	None
AMA6882	Guided Study in Operations Research	E	3	100 : 0	None
AMA6883	Guided Study in Applied Statistics	E	3	100 : 0	None
AMA6884	Guided Study in Financial Mathematics	E	3	100 : 0	None
AMA6885	Guided Study in Engineering Mathematics	E	3	100 : 0	None

AMA6886	Guided Study in Computational Mathematics	E	3	100 : 0	None
AMA6887	Guided Study on Research Topics in Applied Mathematics	E	3	100 : 0	None
AMA67711	Research Seminars	C	1	100 : 0	None
AMA67712	Research Seminars	C	1	100 : 0	(P): AMA67711
AMA67713	Research Seminars	C	1	100 : 0	(P): AMA67712
AMA67714	Research Seminars	C	1	100 : 0	(P): AMA67713
AMA67721	Practicum	C	1	100 : 0	None
AMA67722	Practicum	C	1	100 : 0	None
HTI6081	Ethics: Research, Professional & Personal Perspectives	C	1	100 : 0	None
ELC6001	Presentation Skills for Research Students	C	Nil	100 : 0	None
ELC6002	Thesis Writing for Research Students	C	Nil	100 : 0	None

Subject Description Form

Subject Code	AMA610
Subject Title	Advanced Probability Theory
Credit Value	3
Level	6
Expected background knowledge	A course in Probability Theory and a course in Advanced Calculus
Objectives	To enable students to have an overview and thorough understanding of the modern probability theory.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Apply the concepts of probability, conditional probability and conditional expectations. (b) Calculate probabilities, moments and other related quantities based on given distributions. (c) Understand and apply the laws of large numbers and central limit theorems. (d) Understand and apply martingale limit theory. (e) Understand and apply Brownian motion model.
Subject Synopsis/ Indicative Syllabus	Measure theory concepts needed for probability. Expectation, distributions. Laws of large numbers and central limit theorems for independent random variables. Characteristic function methods. Conditional expectations, martingales and martingale convergence theorems. Brownian Motion.
Teaching/Learning Methodology	The subject will be delivered mainly through lectures and tutorials. The teaching and learning approach is mainly problem-solving oriented. The approach aims at the development of solid mathematical techniques and how the techniques can be applied to solving research and real application problems. Students are encouraged to adopt a deep study approach by employing high level cognitive strategies, such as critical and evaluative thinking, relating, integrating and applying theories to practice.

<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></td><td colspan="5">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td></tr>
<tr><td>1. CA</td><td>40</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Exam</td><td>60</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100 %</td><td></td><td colspan="5"></td></tr>
</table>
Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

The subject focuses on knowledge and understanding of Measure Theory and Probability Theory. The Exam-based assessment is the most appropriate assessment method, including tests and examination. Moreover, assignments are included as a component of continuous assessment so as to keep the students in progress.

Continuous Assessment comprises of assignments and a mid-term test. A written examination is held at the end of the semester.
</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>26Hrs.</td></tr>
<tr><td>▪ Tutorial</td><td>13Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Assignment</td><td>30Hrs.</td></tr>
<tr><td>▪ Self-study</td><td>61Hrs.</td></tr>
<tr><td>Total student study effort</td><td>130Hrs.</td></tr>
</table>
</td></tr>
<tr><td>Reading List and References</td><td>
R. Durrett, Probability: Theory and Examples. Cambridge University Press, 2010; available online at http://www.math.cornell.edu/~durrett/PTE/PTE4_Jan2010.pdf

K.L. Chung, A Course in Probability Theory. Academic Press, 2001.

S.C. Chow and H. Teicher, Probability Theory: Independence, Interchangeability, Martingales. Springer, 2003.
</td></tr>
</table>

Subject Description Form

Subject Code	AMA611
Subject Title	Applied Analysis
Credit Value	3
Level	6
Expected background knowledge	A course in Linear Algebra and a course in Advanced Calculus. A course in Partial Differential Equations or Analysis would be highly recommended.
Objectives	To teach students how to use functional analysis to prove various existence, stability and dynamical results of solutions to partial differential equations (PDEs) arising from Physics, Biology, Geometry and Engineering.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. Learn some basic functional analysis; b. Learn how to use inequalities to prove estimates; c. Prove existence and analyze qualitative features of solutions to PDEs; d. Analyze stability and dynamics of solutions to PDEs.
Subject Synopsis/ Indicative Syllabus	*Basic functional analysis* Banach and Hilbert Spaces; L**p** spaces; Sobolev spaces; inequalities; linear operators and spectrum (discrete and continuous); Compactness. *Fixed point theorems and applications* The contraction mapping; local and global well-posedness;

<table>
<tr><td></td><td>Gateaux and Frechet derivatives; implicit and inverse function theorems; applications to PDEs arising from Physics, Biology, Geometry and Engineering.

Variational Calculus

Functionals; constraints and Lagrange multipliers;
minimization by direct methods; saddle points and the Mountain Pass Lemma; Hamiltonian equations.</td></tr>
<tr><td>Teaching/ Learning Methodology</td><td>The subject will be delivered mainly through lectures and tutorials. Tutorials will be spent answering questions, reviewing some background material and going over tutorial questions that are related to assignments. In addition, tutorials will be spent discussing some possible topics for the mini projects.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods</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. Assignments</td><td>25%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Project and presentation</td><td>25%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>3. Final Exam</td><td>50%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="4"></td></tr>
</table>

The project must be pre-approved by the instructor.

Continuous assessment comprises of assignments and project.

A written examination is held at the end of the semester.</td></tr>
<tr><td>Student Study Effort</td><td>Class contact:</td><td></td></tr>
</table>

Expected	▪ Lecture	26 Hrs.
	▪ Tutorial	13 Hrs.
	Other student study effort:	
	▪ Assignments ▪ Project	30 Hrs. 30 Hrs.
	▪ Self-study	31 Hrs.
	Total student study effort	130 Hrs.
Reading List and References	M. Reed and B. Simon. Methods of Modern Mathematical Physics: Vol. I: Functional Analysis. Academic Press, 1972. E. H. Lieb and M. Loss. Analysis, Graduate studies in Mathematics. American Mathematical Society, Vol. 14, 2nd ed. 2001. G. B. Folland. Real Analysis: modern techniques and their applications. Wiley, New York, 1984. R. C. McOwen. Partial Differential Equations: methods and applications. Prentice Hall, 1996. L. C. Evans. Partial Differential Equations, volume 19 of Graduate studies in mathematics. American Mathematical Society, 1998. P. D. Hislop and I. M. Sigal. Introduction to spectral theory, Vol. 133 of Applied Mathematical Sciences. Springer Verlag, 1996. S. Gustafsson and I.M. Sigal. Mathematical Concepts of Quantum Mechanics. Springer Verlag, 2003.	

Subject Description Form

Subject Code	AMA 612
Subject Title	Numerical methods for Partial Differential Equations
Credit Value	3
Level	6
Expected background knowledge	A course in Differential Equations and a course in Advanced Calculus
Objectives	This subject is to introduce students to numerical techniques for solving partial differential equations, with applications in physics, engineering, finance and economics.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. Gain a deep understanding of algorithms of finite difference and finite element methods for solving partial differential equations; b. Solve simple partial differential equations numerically; c. Gain a basic knowledge of theories of finite difference and finite element methods; d. Apply finite difference or finite element methods to solve problems arising in physics, engineering, finance and economics numerically.
Subject Synopsis/ Indicative Syllabus	*Finite difference methods* Introduction to finite difference methods, Stability, Consistency, Convergence, Lax Equivalent Theorem, Fourier stability analysis, Finite difference methods for model problems. *Finite element methods* Ritz and Galerkin methods, Introduction to finite element methods, Interpolation Theory in Sobolev Spaces, Conforming finite elements

<table>
<tr><td>Teaching/ Learning Methodology</td><td>The subject will be delivered mainly through lectures and tutorials. The lectures will be conducted to introduce numerical methods for partial differential equations in the syllabus, which are then reinforced by learning activities involving demonstration, tutorial exercise and assignments.</td></tr>
</table>

<table>
<tr><td rowspan="2">Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods</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. CA</td><td>40%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Exam</td><td>60%</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:

The subject focuses on knowledge, skill and understanding of <u>Numerical methods for Partial Differential equations</u>, <u>thus, Exam-based assessment</u> is the most appropriate assessment method, including 25% test and 60% examination. Moreover, 15% worth of assignments are included as a component of continuous assessment so as to keep the students in progress.

Continuous Assessment comprises of assignments and tests. A written examination is held at the end of the semester.</td></tr>
<tr><td>Student Study Effort Expected</td><td>Class contact:
▪ Lecture</td><td></td><td>26 Hrs.</td></tr>
</table>

	▪ Tutorial	13 Hrs.
	Other student study effort:	
	▪ Assignment	36 Hrs.
	▪ Self-study	27 Hrs.
	Total student study effort	102 Hrs.
Reading List and References	J.W. Thomas, Numerical partial differential equations—Finite Difference Methods, Springer, 1995. Randall J. LeVeque, Finite Difference Methods for Ordinary and Partial Differential Equations--Steady State and Time Dependent Problems, SIAM: Society for Industrial and Applied Mathematics, 2007. Philippe G. Ciarlet, The Finite Element Method for Elliptic Problems, SIAM: Society for Industrial and Applied Mathematics; 2nd edition, 2002. O.C. Zienkiewicz and K. Morgan, Finite Element Method, John Wiley, 1983.	

Subject Description Form

Subject Code	AMA613
Subject Title	Mathematics Seminar
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	A compulsory subject for research students of AMA enrolled for at least six months.
Objectives	The aim of this subject is to provide education on students' oral and written presentations of research results.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Do research on an agreed topic/area/issue. (b) Gain an in-depth understanding of the literature related to topics of interest. (c) Develop written skills for presentation of research results. (d) Develop oral academic communication and presentation skills.
Subject Synopsis/ Indicative Syllabus	Topics presented to be determined by the participants, coordinated by the subject examiner (coordinator).
Teaching/Learning Methodology	Subject lecturer teaches students about both oral and written presentation skills and chairs all students' oral presentations. Students are required to research, develop and deliver a formal presentation using appropriate audiovisual media support and handouts. The presentation assessment tool includes three graded components: content, communication, and organization. The report is expected to include but not limited to problem identification, methodology, solutions, implementation, interpretations, conclusions, and discussions. Students' presentation materials are required to be submitted to the subject lecturer for checking before class.

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. Two oral presentations	50%	✓	✓		✓		
2. One research report	50%	✓	✓	✓			
Total	100 %						

Selected topics will be presented by the students. Content, communication and organization will be included in assessing the oral presentation of the student; and content and organization will be included in assessing the research report.

Student Study Effort Required

Class contact:	
▪ Three lectures	6 Hrs.
▪ Presentation of supervised research topic	10 Hrs.
▪ Presentation of selected topic	10 Hrs.
Other student study effort:	112 Hrs.
▪ Self-study	Hrs.
Total student study effort	138 Hrs.

Reading List and References

Bowden, John	Writing a Report: How to Prepare, Write and Present Powerful Reports, 6th ed.	Oxford, 2002
Moore, Nick	How to Do Research: a Practical Guide to Designing and Managing Research Projects, 3rd ed.	London: Facet Pub., 2006
Van Emden, Joan	Presentation Skills for Students	Basingstoke: Palgrave Macmillan, 2004

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Subject Description Form

Subject Code	AMA614
Subject Title	Mathematical Statistics
Credit Value	3
Level	6
Expected background knowledge	A course in Probability and Statistics and a course in Advanced Calculus
Objectives	To enable students to have an overview and thorough understanding of the modern mathematical statistics theory.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Use the approach of maximum likelihood to obtain the estimator of parameters of distributions and derive the asymptotic properties of estimators (b) Find the UMVU estimators. (c) Apply the method of pivotal quantity to obtain interval estimates. (d) Use the likelihood ratio principle to construct statistical tests. (e) Find uniformly most powerful tests based on the Neyman-Pearson Lemma.
Subject Synopsis/ Indicative Syllabus	This course is concerned with the fundamental theory of statistical inference. Topics include exponential families of distributions, sufficient statistics, complete statistics, convex loss functions, UMVU estimators, performance of the estimators, maximum likelihood estimation, the information inequality, large-sample comparisons of estimators and asymptotic efficiency.
Teaching/Learning Methodology	The subject will be delivered mainly through lectures and tutorials. The teaching and learning approach is mainly problem-solving oriented. The approach aims at the development of solid mathematical techniques and how the techniques can be applied to solving research and real application problems. Students are encouraged to adopt a deep study approach by employing high level cognitive strategies, such as critical and evaluative thinking, relating, integrating and applying theories to practice.

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	e
1. CA	40	✓	✓	✓	✓	✓
2. Exam	60	✓	✓	✓	✓	✓
Total	100 %					

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

The subject focuses on knowledge and understanding of Statistical Theory. The Exam-based assessment is the most appropriate assessment method, including tests and examination. Moreover, assignments are included as a component of continuous assessment so as to keep the students in progress.

Continuous Assessment comprises of assignments and a mid-term test. A written examination is held at the end of the semester.

Student Study Effort Expected

Class contact:	
▪ Lecture	26Hrs.
▪ Tutorial	13Hrs.
Other student study effort:	
▪ Assignment	30Hrs.
▪ Self-study	61Hrs.
Total student study effort	130Hrs.

Reading List and References

J. Shao, Mathematical Statistics. Springer. 2003.

G. Casella and R. L. Berger, Statistical Inference. Second edition, Thomson, 2002.

E. Lehmann and G. Casella, Theory of Point Estimation. Second Edition, 1998

Ferguson, T. S. A Course in Large Sample Theory. 1996

Subject Description Form

Subject Code	AMA615
Subject Title	Nonlinear Optimization Methods
Credit Value	3
Level	6
Expected background knowledge	A course in Linear Algebra and a course in Advanced Calculus
Objectives	To enable students to learn to use more advanced mathematical and computational techniques applicable in solving real engineering and management problems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Understand basic theory of nonlinear optimization. (b) Solve unconstrained optimization problems. (c) Solve constrained optimization problems.
Subject Synopsis/ Indicative Syllabus	**I. Unconstrained Optimization** 1.1 First, second order optimality conditions Convex optimization 1.2 First order methods Steepest descent methods, Conjugate gradient methods, Trust region methods 1.3 Second order methods Newton methods, Quasi-Newton methods, Trust region Newton methods 1.4 Non-differentiable objective function First order optimality condition, Proximal point methods, Smoothing methods **II. Constrained Optimization** 2.1 First, second order optimality conditions, KKT conditions, Constraint Qualification 2.2 Penalty methods 2.3 Augmented Lagrangian methods (ALM) 2.4 Alternating direction method of multipliers (ADMM) **III. Optimization methods in Data Science** 3.1 Least absolute shrinkage and selection operator (Lasso), Semi-smooth Newton methods 3.2 Folded concave penalized estimation, Difference-convex (DC) optimization methods 3.3 Non-Lipschitz regularization, Smoothing methods 3.4 Composite nonsmooth nonconvex optimization in deep learning
Teaching/Learning	The subject will be delivered mainly through lectures and tutorials. The

Methodology

teaching and learning approach is mainly problem-solving oriented. The approach aims at the development of mathematical techniques and how the techniques can be applied to solving problems. Students are encouraged to adopt a deep study approach by employing high level cognitive strategies, such as critical and evaluative thinking, relating, integrating and applying theories to practice.

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. Assignments	20%	✓	✓	✓
2. Mid-term test	20%	✓	✓	✓
3. Examination	60%	✓	✓	✓
Total	100 %			

Continuous Assessment comprises of assignments and a mid-term test. A written examination is held at the end of the semester.

Student Study Effort Required

Class contact:	
▪ Lecture	26 Hrs.
▪ Tutorial	13 Hrs.
Other student study effort:	
▪ Assignment	23 Hrs.
▪ Self-study	40 Hrs.
▪ Total student study effort	102 Hrs.

Reading List and References

Fletcher, R.	Practical Methods of Optimization, 2nd Edition	Wiley, 1987
Nocedal, J. and Wright, S.J.	Numerical Optimization, 2nd Edition	Springer, 2006
Dennis, J.E. and Schnabel, R.B.	Numerical Methods for Unconstrained Optimization and Nonlinear Equations	SIAM, 1996
Mangasarian, O.L.	Nonlinear Programming	SIAM, 1994
Rockafellar, R.T.	Convex Analysis	Princeton University Press, 1970
Facchinei, F. and Pang, J-S.	Finite-Dimensional Variational Inequalities and Complementarity Problems	Springer, 2003

Subject Description Form

Subject Code	AMA 616
Subject Title	Statistics for Finance
Credit Value	3
Level	6
Expected background knowledge	A course in Statistical Analysis and a course in Advanced Calculus
Objectives	To give a comprehensive introduction into important ideas of financial mathematics and statistics for the modelling and statistical analysis of financial data.
Intended Learning Outcomes	Upon satisfactory completion of the subject, students should be able to: a. Gain a deep understanding of option pricing model and financial time series; b. Solve simple option pricing problems numerically; c. Carry out basic statistical analysis on financial data; d. Apply option pricing theory to model new financial products and various statistical models to model the financial time series.
Subject Synopsis/ Indicative Syllabus	*Option pricing theory* Derivatives, Arbitrage, Wiener process, binomial processes, geometric random walks, stochastic integrals, Ito's Lemma, Black-Scholes model, hedging. European options, Binomial model, Cox-Ross-Rubinstein approach. American options, arbitrage relationship, trinomial model, numerical techniques, applications

	Financial Time series analysis Econometric models, the random walk hypothesis, unit root test, ARIMA models. ARCH and GARCH models, Exponential GARCH, stochastic volatility, multivariate GARCH models, applications.
Teaching/ Learning Methodology	The subject will be delivered mainly through lectures and tutorials, which are then reinforced by learning activities involving demonstration, tutorial exercises and assignments.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. CA	40%	✓	✓	✓	✓
2. Exam	60%	✓	✓	✓	✓
Total	100 %				

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

The subject focuses on knowledge, skill and understanding of **Statistics of Finance**, **Exam-based assessment** is the most appropriate assessment method, including tests and examination. Moreover, assignments are included as a component of continuous assessment so as to keep the students in progress.

Continuous Assessment comprises of assignments and tests. A written examination is held at the end of the semester.

Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorial	13 Hrs.
	Other student study effort:	
	▪ Assignment	36 Hrs.
	▪ Self-study	27 Hrs.
	Total student study effort	102 Hrs.
Reading List and References	J. Franke, W. Hardle and C.M. Hafner, Statistics of Financial Markets, 3rd Edition, 2012. P.J. Wilmott, Quantitiative Finance, John Wiley & Sons Ltd., 2007. J.C. Hull, Options, Futures , and Other Derivatives, 8th Edition, Prentice Hall, 2012. C. Chatfield, The Analysis of Time Series: an introduction, 6th Edition, Chapman & Hall/CRC, 2003. J.D. Cryer and K.S. Chan, Time Series Analysis with Applications in R, 2nd Edition, Springer, 2008. R.S. Tsay, Analysis of financial time series, 3rd edition, Wiley, 2010.	

Subject Description Form

Subject Code	AMA6881
Subject Title	Guided Study in Applied Optimization
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Postgraduate course
Objectives	♦ To broaden students' knowledge in applied optimization through literature searching in various fields. ♦ To enhance student's written and oral presentation skills through their own research work or topics of their interests.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Acquire knowledge and awareness of the latest advances in research development in applied optimization from literature related to topics of interest. (b) Carry out research on an agreed topic (c) Improve written and oral presentation skills of research results on current topics of interest.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	♦ The topic is determined by the Supervisor of the M. Phil/Ph. D student. ♦ Students must hand the completed guided study report to supervisor with adequate of related literature references. ♦ Student should consult supervisor regularly about the progress of the literature reviewing progress.
Teaching/Learning Methodology *(Note 3)*	Meet assigned supervisor regularly Hand the report with full list of references

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<tr><td>Total student study effort</td><td>120 Hrs.</td></tr>
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Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon completion of the subject. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/ Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time over-crowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
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Subject Description Form

Subject Code	AMA6882
Subject Title	Guided Study in Operations Research
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Postgraduate course
Objectives	♦ To broaden students' knowledge in operations research through literature searching in various fields. ♦ To enhance student's written and oral presentation skills through their own research work or topics of their interests.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Acquire knowledge and awareness of the latest advances in research development in operations research from literature related to topics of interest. (b) Carry out research on an agreed topic (c) Improve written and oral presentation skills of research results on current topics of interest.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	♦ The topic is determined by the Supervisor of the M. Phil/Ph. D student. ♦ Students must hand the completed guided study report to supervisor with adequate of related literature references. ♦ Student should consult supervisor regularly about the progress of the literature reviewing progress.
Teaching/Learning Methodology *(Note 3)*	Meet assigned supervisor regularly Hand the report with full list of references

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Note 1: Intended Learning Outcomes
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Note 2: Subject Synopsis/ Indicative Syllabus
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Subject Description Form

Subject Code	AMA6883
Subject Title	Guided Study in Applied Statistics
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Postgraduate course
Objectives	♦ To broaden students' knowledge in applied statistics through literature searching in various fields. ♦ To enhance student's written and oral presentation skills through their own research work or topics of their interests.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Acquire knowledge and awareness of the latest advances in research development in applied statistics from literature related to topics of interest. (b) Carry out research on an agreed topic (c) Improve written and oral presentation skills of research results on current topics of interest.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	♦ The topic is determined by the Supervisor of the M. Phil/Ph. D student. ♦ Students must hand the completed guided study report to supervisor with adequate of related literature references. ♦ Student should consult supervisor regularly about the progress of the literature reviewing progress.
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Subject Description Form

Subject Code	AMA6884
Subject Title	Guided Study in Financial Mathematics
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Postgraduate course
Objectives	♦ To broaden students' knowledge in financial mathematics through literature searching in various fields. ♦ To enhance student's written and oral presentation skills through their own research work or topics of their interests.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Acquire knowledge and awareness of the latest advances in research development in financial mathematics from literature related to topics of interest. (b) Carry out research on an agreed topic (c) Improve written and oral presentation skills of research results on current topics of interest.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	♦ The topic is determined by the Supervisor of the M. Phil/Ph. D student. ♦ Students must hand the completed guided study report to supervisor with adequate of related literature references. ♦ Student should consult supervisor regularly about the progress of the literature reviewing progress.
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Subject Description Form

Subject Code	AMA6885
Subject Title	Guided Study in Engineering Mathematics
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Postgraduate course
Objectives	♦ To broaden students' knowledge in engineering mathematics through literature searching in various fields. ♦ To enhance student's written and oral presentation skills through their own research work or topics of their interests.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Acquire knowledge and awareness of the latest advances in research development in engineering mathematics from literature related to topics of interest. (b) Carry out research on an agreed topic (c) Improve written and oral presentation skills of research results on current topics of interest.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	♦ The topic is determined by the Supervisor of the M. Phil/Ph. D student. ♦ Students must hand the completed guided study report to supervisor with adequate of related literature references. ♦ Student should consult supervisor regularly about the progress of the literature reviewing progress.
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Subject Description Form

Subject Code	AMA6886
Subject Title	Guided Study in Computational Mathematics
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Postgraduate course
Objectives	♦ To broaden students' knowledge in computational mathematics through literature searching in various fields. ♦ To enhance student's written and oral presentation skills through their own research work or topics of their interests.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Acquire knowledge and awareness of the latest advances in research development in computational mathematics from literature related to topics of interest. (b) Carry out research on an agreed topic (c) Improve written and oral presentation skills of research results on current topics of interest.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	♦ The topic is determined by the Supervisor of the M. Phil/Ph. D student. ♦ Students must hand the completed guided study report to supervisor with adequate of related literature references. ♦ Student should consult supervisor regularly about the progress of the literature reviewing progress.
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This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method purports to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	AMA6887
Subject Title	Guided Study on Research Topics in Applied Mathematics
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Postgraduate course
Objectives	♦ To broaden students' knowledge in applied mathematics through literature searching in various fields including applied optimization, operations research, applied statistics, financial mathematics, engineering mathematics, and computational mathematics. ♦ To enhance student's written and oral presentation skills through their own research work or topics of their interests.
Intended Learning Outcomes *(Note 1)*	Upon completion of the subject, students will be able to: (a) Acquire knowledge and awareness of the latest advances in research development in applied mathematics from literature related to topics of interest. (b) Do research on an agreed topic (c) Improve written and oral presentation skills of research results on current topics of interest.
Subject Synopsis/ Indicative Syllabus *(Note 2)*	♦ The topic is determined by the Supervisor of the M. Phil/Ph. D student. ♦ Students must hand the completed guided study report to supervisor with adequate of related literature references. ♦ Student should consult supervisor regularly about the progress of the literature reviewing progress.

<table>
<tr><td>Teaching/Learning Methodology
(Note 3)</td><td>Meet assigned supervisor regularly
Hand the report with full list of references</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes
(Note 4)</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></td></tr>
<tr><td>Continuous assessment</td><td>100</td><td>√</td><td>√</td><td>√</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></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:

Supervisor will go through the literature report and project report, and check the references and give a final grade to the final report
</td></tr>
<tr><td rowspan="8">Student Study Effort Expected</td><td>Student contact:</td><td></td></tr>
<tr><td>▪ Seminar/Tutorial</td><td>26 Hrs.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Assignment/mini-project</td><td>34Hrs.</td></tr>
<tr><td>▪ Self-study</td><td>60 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>120 Hrs.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Reading List and References</td><td colspan="2"></td></tr>
</table>

Note 1: Intended Learning Outcomes
Intended learning outcomes should state what students should be able to do or attain upon completion of the subject. Subject outcomes are expected to contribute to the attainment of the overall programme outcomes.

Note 2: Subject Synopsis/ Indicative Syllabus
The syllabus should adequately address the intended learning outcomes. At the same time over-crowding of the syllabus should be avoided.

Note 3: Teaching/Learning Methodology
This section should include a brief description of the teaching and learning methods to be employed to facilitate learning, and a justification of how the methods are aligned with the intended learning outcomes of the subject.

Note 4: Assessment Method
This section should include the assessment method(s) to be used and its relative weighting, and indicate which of the subject intended learning outcomes that each method purports to assess. It should also provide a brief explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes.

Subject Description Form

Subject Code	AMA67711
Subject Title	Research Seminars
Credit Value	1
Level	6
Pre-requisite / Co-requisite/ Exclusion	A compulsory subject for research students of AMA
Objectives	The aim of this subject is to provide students with the opportunity to learn the latest advances in Applied Mathematics and facilitate communications with experts in the field.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Gain a good understanding of different advanced topics. (b) Learn oral academic communication and presentation skills.
Subject Synopsis/ Indicative Syllabus	Seminars to be attended are determined by the students and chief supervisors.
Teaching/Learning Methodology	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. 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.
Assessment Methods in Alignment with Intended Learning Outcomes	See table below

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b				
1. Attend 10 research seminars	80%	✓	✓				
2. One report on one of the attended seminars	20%	✓	✓				
Total	100 %						

Subject Description Form

<table>
<tr><td>Subject Code</td><td>AMA67712</td></tr>
<tr><td>Subject Title</td><td>Research Seminars</td></tr>
<tr><td>Credit Value</td><td>1</td></tr>
<tr><td>Level</td><td>6</td></tr>
<tr><td>Pre-requisite / Co-requisite/ Exclusion</td><td>A compulsory subject for research students of AMA</td></tr>
<tr><td>Objectives</td><td>The aim of this subject is to provide students with the opportunity to learn the latest advances in Applied Mathematics and facilitate communications with experts in the field.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
(a) Gain a good understanding of different advanced topics.
(b) Learn oral academic communication and presentation skills.</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td>Seminars to be attended are determined by the students and chief supervisors.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>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.

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.</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></td><td></td><td></td><td></td></tr>
<tr><td>1. Attend 10 research seminars</td><td>80%</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2. One report on one of the attended seminars</td><td>20%</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>
</table>

Subject Description Form

Subject Code	AMA67713
Subject Title	Research Seminars
Credit Value	1
Level	6
Pre-requisite / Co-requisite/ Exclusion	A compulsory subject for research students of AMA
Objectives	The aim of this subject is to provide students with the opportunity to learn the latest advances in Applied Mathematics and facilitate communications with experts in the field.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Gain a good understanding of different advanced topics. (b) Learn oral academic communication and presentation skills.
Subject Synopsis/ Indicative Syllabus	Seminars to be attended are determined by the students and chief supervisors.
Teaching/Learning Methodology	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. 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.
Assessment Methods in Alignment with Intended Learning Outcomes	See table below

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b				
1. Attend 10 research seminars	80%	✓	✓				
2. One report on one of the attended seminars	20%	✓	✓				
Total	100 %						

Subject Description Form

<table>
<tr><td>Subject Code</td><td>AMA67714</td></tr>
<tr><td>Subject Title</td><td>Research Seminars</td></tr>
<tr><td>Credit Value</td><td>1</td></tr>
<tr><td>Level</td><td>6</td></tr>
<tr><td>Pre-requisite / Co-requisite/ Exclusion</td><td>A compulsory subject for research students of AMA</td></tr>
<tr><td>Objectives</td><td>The aim of this subject is to provide students with the opportunity to learn the latest advances in Applied Mathematics and facilitate communications with experts in the field.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
(a) Gain a good understanding of different advanced topics.
(b) Learn oral academic communication and presentation skills.</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td>Seminars to be attended are determined by the students and chief supervisors.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>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.

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<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></td><td></td><td></td><td></td></tr>
<tr><td>1. Attend 10 research seminars</td><td>80%</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2. One report on one of the attended seminars</td><td>20%</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>
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</td></tr>
</table>

Subject Description Form

<table>
<tr><td>Subject Code</td><td>AMA67721</td></tr>
<tr><td>Subject Title</td><td>Practicum</td></tr>
<tr><td>Credit Value</td><td>1</td></tr>
<tr><td>Level</td><td>6</td></tr>
<tr><td>Pre-requisite / Co-requisite/ Exclusion</td><td>A compulsory subject for PhD students of AMA</td></tr>
<tr><td>Objectives</td><td>The aim of this subject is to provide students with the opportunity to engage in teaching / research supporting activities in AMA.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
(a) Gain an understanding of teaching activities.
(b) Learn to support organized research activities.</td></tr>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td>Teaching/research supporting activities are assigned by the HoD or his/her delegate.</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>To earn one credit, students will be required to engage in teaching/research supporting activities assigned by the HoD or his/her delegate for 6 hours/week in any 13-week semester.

The HoD or his/her delegate is required to:
a. ensure that the activities are structured and can be assessed properly;
b. submit, 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.</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></td><td></td><td></td><td></td></tr>
<tr><td>1. Undertake teaching/research supporting activities</td><td>100%</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="6"></td></tr>
</table>
</td></tr>
</table>

Subject Description Form

<table>
<tr><td>Subject Code</td><td>AMA67722</td></tr>
<tr><td>Subject Title</td><td>Practicum</td></tr>
<tr><td>Credit Value</td><td>1</td></tr>
<tr><td>Level</td><td>6</td></tr>
<tr><td>Pre-requisite / Co-requisite/ Exclusion</td><td>A compulsory subject for PhD students of AMA</td></tr>
<tr><td>Objectives</td><td>The aim of this subject is to provide students with the opportunity to engage in teaching / research supporting activities in AMA.</td></tr>
<tr><td>Intended Learning Outcomes</td><td>Upon completion of the subject, students will be able to:
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<tr><td>a</td><td>b</td><td></td><td></td><td></td><td></td></tr>
<tr><td>1. Undertake teaching/research supporting activities</td><td>100%</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td></tr>
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</table>
</td></tr>
</table>

Intended Learning Outcome of Individual MPhil Programme against the University's Policy & Guidelines on Learning Outcomes for Graduates of MPhil Programmes*

Programme Title: Research Postgraduate Programme in Applied Mathematics

Hosted by: Department of Applied Mathematics

Institutional Learning Outcomes	Intended Learning Outcomes of Individual Research Degree Programme
Research and Scholarship Excellence MPhil graduates of PolyU should demonstrate advanced competence in research methods, possess in-depth knowledge and skills in their area of study and attain the ability to apply their knowledge and act as leaders in analyzing and solving identified issues and problems in their area of study. They should also be able to disseminate/communicate effectively their research findings in publications, conferences and classrooms.	**Research and Scholarship Excellence** MPhil graduates of AMA should develop and demonstrate research skills and knowledge in applied mathematics; critically analyze new and complex information from real problems, and effectively utilize research methodologies in applied mathematics.
Originality MPhil graduates of PolyU will be versatile problem solvers with good mastery of critical and creative thinking methodologies. They can generate practical and innovative solutions to problems in their area of study.	**Originality** MPhil graduates of AMA should 1. recognize the importance of research ethics; 2. provide novel solutions to research problems and effectively interpret new research results.
Lifelong Learning Capability MPhil graduates of PolyU will have an enhanced capability for continual professional development through inquiry and reflection on knowledge in their area of study.	**Lifelong Learning Capability** MPhil graduates of AMA should learn up-to-date research advances and developments in applied mathematics.

Intended Learning Outcome of Individual PhD Programme against the University's Policy & Guidelines on Learning Outcomes for Graduates of PhD Programmes*

Programme Title: **Research Postgraduate Programme in Applied Mathematics**

Hosted by : **Department of Applied Mathematics**

Institutional Learning Outcomes	Intended Learning Outcomes of Individual Research Degree Programme
Research and Scholarship Excellence PhD graduates of PolyU should demonstrate state-of-the-art expertise and knowledge in their area of study, possessed superior competence in research methodologies and contribute as leaders in creating new knowledge through analysis, diagnosis and synthesis. They should also be able to disseminate/communicate their research ideas and findings effectively and efficiently in publications, conferences and classrooms.	**Research and Scholarship Excellence** PhD graduates of AMA should 1. develop and demonstrate research skills and knowledge in applied mathematics; critically analyze new and complex information from real problems, and effectively utilize research methodologies in applied mathematics; 2. present results with good scientific writing and presentation skills.
Originality PhD graduates of PolyU will be able to think out of the box. They will be innovative problem solvers with excellent mastery of critical and creative thinking methodologies. They will create original solutions to issues and problems pertaining to their area of expertise and the society in general.	**Originality** PhD graduates of AMA should 1. recognize the importance of research ethics; 2. provide novel solutions to research problems and effectively interpret new research results.
Lifelong Learning Capability PhD graduates of PolyU will demonstrate the ability to engage in an enduring quest for knowledge and an enhanced capability for continual academic/professional development through self-directed research in their area of study.	**Lifelong Learning Capability** PhD graduates of AMA should learn up-to-date research advances and developments in applied mathematics.