

MAE5100	Advanced Engineering Design and Optimization	3
MAE5110	Quantum Control	3
MAE801T-810T (ACE801T-810T)	M.Phil. Thesis Research I - X	3 each
MAE901T-916T (ACE901T-916T)	Ph.D. Thesis Research I - XVI	3 each

() Old course codes used in 2006-07 and before are included in brackets.

Course Description

MAE5010

Advanced Robotics

Lagrange formulation of robot dynamics, Newton-Euler equations; motion control, force control, visual servoing, grasping analysis, object manipulation; sensors and sensor networks, advanced topics in recent development of robotic theory and applications. (Equivalent to ACE5030)

MAE5020

Topics in Linear Control Systems

Advanced topics in recent development of linear control theory and its applications. The detailed course contents may be changed from year to year depending on the current development. (Equivalent to ACE5050)

MAE5030

Topics in Computer-Aided Geometric Design

Advanced topics in recent development of computer-aided geometric design. The detailed course contents may be changed from year to year depending on the current development. (Equivalent to ACE5010)

MAE5040

Computer Vision

Camera models. Stereo vision, camera calibration and stereo calibration. Shape from motion, camera motion estimation and motion tracking. Shape from boundary. Active range sensing. Early vision. Multimedia applications like image transfer and image mosaic construction. Industrial applications. (Equivalent to ACE5020)

MAE5050

MEMS and Nano-Robotics

Introduction to MEMS/NEMS devices. Micro/Nano fabrication techniques. MEMS/NEMS design methodology. Experimental methods for Micro/Nano devices. Applications for MEMS/NEMS. Dominant physical phenomena in the Micro/Nano worlds. Micro and Nano scale robotics and assembly. (Equivalent to ACE5090)

MAE5060

Computational Intelligence

Concepts, models, methods, and applications of computational intelligence. Topics include neural networks, support vector machines, fuzzy systems, simulated annealing, genetic algorithms, and their applications to control, robotics, automation, manufacturing, and transportation. (Equivalent to ACE5070)

MAE5070

Nonlinear Control Systems

Ordinary differential equation description of nonlinear state space systems. Phase plane analysis. Linearization. Concepts of stability. Lyapunov theory. LaSalle theory. Limit cycles. Feedback linearization. Sliding mode control. Backstepping. (Equivalent to ACE5100)

MAE5080

Smart Materials and Structures

Overview of smart materials technology. Characteristics of smart materials such as piezoelectric materials, magnetorheological fluids, and shape memory alloys. Smart actuators and sensors. Structural modelling and design. Dynamics and control for smart structures. Integrated system analysis. Applications in biomedical devices, precision machinery, transportation, and buildings. (Equivalent to ACE5120)

MAE5090

Topics in Robotics

One or more of the following topics will be discussed in the class. Advanced robot control: adaptive control; cooperative robot control; underactuated robot control; multi-finger hand control. Mobile robot: obstacle avoidance; learning; control; and mobile manipulators. Space robotics: dynamics; control; telepresence. Human and robot interaction: interface; learning skills. Biorobotics: robots and intelligent systems for medical, healthcare, and laboratory automation and clinic surgery. Robot motion planning: configuration space; search algorithm; potential field, and sensor-based motion planning. (Equivalent to ACE5110)

MAE5100

Advanced Engineering Design and Optimization

To provide in-depth understanding of the principles and tools of engineering system design, statistical optimization methods, Design for Six Sigma (DFSS), TRIZ, and complex system design.

MAE5110

Quantum Control

Mathematics foundation: Hilbert spaces; manifolds; groups; Lie groups and Lie algebras. Physics foundation: quantum phenomena; states and operators; observables and measurement; quantum dynamics. Quantum control systems: modeling; controllability and observability; optimal quantum control.

MAE801T

M.Phil. Thesis Research I

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. (Equivalent to ACE801T)

MAE802T

M.Phil. Thesis Research II

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE801T. (Equivalent to ACE802T)

MAE803R

Thesis Research

In this course, a student is required to meet with his/her supervisor regularly who provides necessary guidance and supervision to write up a thesis and monitors the student's academic progress.

MAE803T

M.Phil. Thesis Research III

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE802T. (Equivalent to ACE803T)

MAE804T

M.Phil. Thesis Research IV

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE803T. (Equivalent to ACE804T)

MAE805T

M.Phil. Thesis Research V

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE804T. (Equivalent to ACE805T)

MAE806R

Thesis Research

In this course, a student is required to meet with his/her supervisor regularly who provides necessary guidance and supervision to write up a thesis and monitors the student's academic progress.

MAE806T

M.Phil. Thesis Research VI

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE805T. (Equivalent to ACE806T)

MAE807T

M.Phil. Thesis Research VII

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE806T. (Equivalent to ACE807T)

MAE808T

M.Phil. Thesis Research VIII

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE807T. (Equivalent to ACE808T)

MAE809T

M.Phil. Thesis Research IX

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE808T. (Equivalent to ACE809T)

MAE810T

M.Phil. Thesis Research X

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE809T. (Equivalent to ACE810T)

MAE812R

Thesis Research

In this course, a student is required to meet with his/her supervisor regularly who provides necessary guidance and supervision to write up a thesis and monitors the student's academic progress.

MAE901T

Ph.D. Thesis Research I

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. (Equivalent to ACE901T)

MAE902T

Ph.D. Thesis Research II

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE901T. (Equivalent to ACE902T)

MAE903T

Ph.D. Thesis Research III

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE902T. (Equivalent to ACE903T)

MAE904T

Ph.D. Thesis Research IV

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE903T. (Equivalent to ACE904T)

MAE905T

Ph.D. Thesis Research V

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE904T. (Equivalent to ACE905T)

MAE906T

Ph.D. Thesis Research VI

To carry out research on a topic agreed by the supervisor. A written report is required for

each term until the thesis is finally submitted. Prerequisite: MAE905T. (Equivalent to ACE906T)

MAE907T

Ph.D. Thesis Research VII

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE906T. (Equivalent to ACE907T)

MAE908T

Ph.D. Thesis Research VIII

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE907T. (Equivalent to ACE908T)

MAE909T

Ph.D. Thesis Research IX

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE908T. (Equivalent to ACE909T)

MAE910T

Ph.D. Thesis Research X

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE909T. (Equivalent to ACE910T)

MAE911T

Ph.D. Thesis Research XI

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE910T. (Equivalent to ACE911T)

MAE912T

Ph.D. Thesis Research XII

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE911T. (Equivalent to ACE912T)

MAE913T

Ph.D. Thesis Research XIII

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE912T. (Equivalent to ACE913T)

MAE914T

Ph.D. Thesis Research XIV

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE913T. (Equivalent to ACE914T)

MAE915T

Ph.D. Thesis Research XV

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE914T. (Equivalent to ACE915T)

MAE916T

Ph.D. Thesis Research XVI

To carry out research on a topic agreed by the supervisor. A written report is required for each term until the thesis is finally submitted. Prerequisite: MAE915T. (Equivalent to ACE916T)

Study Scheme

I. **M.Phil.-Ph.D. Programme in Mechanical and Automation Engineering (Full time and/or Part time)**

A. **M.Phil. Student (Full time)**

1. *Coursework Requirement*

(a) Lecture courses

(Applicable to students admitted in 2009-10 and thereafter)

- Each M.Phil. student is required to complete at least four graduate courses (with a total of 12 units) at code 5000 level or above offered by the Division or by other Divisions as prescribed by the supervisor and the Division Head. With permission of the supervisor and the Division Head, undergraduate courses (coded 4000 level) may substitute at most one of the graduate courses. In any case, at least 6 units must be MAE5000 level or above courses. Student shall consult and obtain permission from the supervisor on course selection (the supervisor's signature on the course selection form is needed).
- Students must achieve no lower than grade "B-" in each of the courses taken that count toward the above requirement.

(Applicable to students admitted in 2008-09)

- Each M.Phil. student is required to complete at least four graduate courses (with a total of 12 units) at code 5000 level or above related to their research as recommended by the thesis supervisor with the approval of the Division Head. Undergraduate courses (coded 4xxx or below) cannot be used to fulfill this requirement.
- Students must achieve no lower than grade "B-" in each of the courses taken that count toward the above requirement.

(b) Thesis research courses

Each M.Phil. student must register for the relevant Thesis Research Course in every term throughout his/her study period. A written report is required to submit at the end of each term. In addition, each M.Phil. student is required to give a presentation on his/her research progress after the first year of study.

- Full-time M.Phil. students: MAE806R
- Continuing M.Phil. students: MAE803R

2. Other Requirements

- (a) Students are required to submit a research thesis and pass an oral examination for graduation.
- (b) IT Proficiency Test. (Please refer to “Student IT Competence”.)
- (c) Complete an Improving Postgraduate Learning (IPL) module on “Observing Intellectual Property and Copyright Law during Research”. This will be an online module and relevant information can be accessed from the website: www.cuhk.edu.hk/clear/programmes/programmes.htm.
- (d) Students are required to attend IPL modules on “General Safety”. Students should consult Division for details.

B. Ph.D. Student (Pre-candidacy) (Full-time and Part-time)

The “candidacy requirement” composes of three major parts, namely, coursework requirement, candidacy examination, and thesis proposal (and oral defence). Students must complete and fulfill all three parts within the “maximum period for fulfilling candidacy requirements”. Details of the requirement are listed below:

1. Coursework Requirement

- (a) Lecture courses

(Applicable to students admitted in 2009-10 and thereafter)

- Each Ph.D. student is required to complete at least four graduate courses (with a total of 12 units) at code 5000 level or above offered by the Division or by other Divisions as prescribed by the supervisor and the Division Head. With permission of the supervisor and the Division Head, undergraduate courses (coded 4000 level) may substitute at most one of the graduate courses. In any case, at least 6 units must be MAE5000 level or above courses. Student shall consult and obtain permission from the supervisor on course selection (the supervisor’s signature on the course selection form is needed.)
- Students must achieve no lower than grade “B-” in each of the courses taken that count toward the above requirement.
- Some of the lecture course requirement could be exempted if the Division find that there are equivalent courses taken by the student in his/her previously obtained postgraduate qualification.

(Applicable to students admitted in 2008-09)

- Each Ph.D. student is required to complete at least four graduate courses (with a total of 12 units) at code 5000 level or above related to their research as recommended by the thesis supervisor with the approval of the Division Head. Undergraduate courses (coded 4xxx or below) cannot be used to fulfill this requirement.
- Students must achieve no lower than grade “B-” in each of the courses taken that count toward the above requirement.
- Some of the lecture course requirement could be exempted if the Division find that there are equivalent courses taken by the student in his/her previously obtained postgraduate qualification.

- (b) Thesis research courses
Each Ph.D. student must register for the relevant Thesis Research Course in every term throughout his/her study period. A written report is required to submit at the end of each term.
- Full-time Ph.D. (pre-candidacy) students: MAE806R
 - Part-time Ph.D. (pre-candidacy) students: MAE803R

2. *Candidacy Examination*

- (a) Each student is required to pass a candidacy examination within the maximum period of his/her pre-candidacy stage for advancement to his/her post-candidacy stage.
- (b) It includes a written part and an oral part (refer to item 3 below).
- (c) The written part consists of problems in designated areas of the Division. The student is required to answer a required number of questions. A mandatory technical writing part is also included.
- (d) The examination will be arranged twice per year.
- (e) A student is required to discontinue from his/her Ph.D. study if he/she fails to achieve a Pass grade after two attempts in the candidacy examination.

3. *Thesis Proposal and Oral Defence*

- (a) Students are required to submit a written thesis proposal and pass the oral defence of the proposal.
- (b) The oral part includes a presentation on the student's thesis proposal, followed by a period of questioning from a Committee appointed by the Division.
- (c) Based on the student's performance in the written part, the quality of the thesis proposal, and the student's demonstrated abilities in pursuing the proposed research, the Committee makes a recommendation to the Division: Pass or Fail.
- (d) For student with a Fail grade, the Committee decides one of the following options for him/her:
- take the candidacy examination (or part of it) again the immediate next time;
 - switch to MPhil stream.
 - discontinue the study immediately (applicable to students admitted in 2009-10 and thereafter)

4. *Remarks*

For the advancement to his/her post-candidacy stage, each Ph.D. student is required to pass:

- (a) Coursework requirement
- (b) Candidacy examination
- (c) Thesis proposal and oral defence

C. Ph.D. Student (Post-candidacy) (Full-time and Part-time)

1. *Coursework Requirement*

- (a) Lecture courses
- Each Ph.D. student is required to complete at least one graduate course (with a total of 3 units) during the post-candidacy stage at code 5000 level and above related to their research as recommended by the thesis supervisor with the approval of the Division Head. Undergraduate courses (coded 4xxx or below) cannot be used to fulfill this requirement.

- Students must achieve no lower than grade “B-” in each of the courses taken that count toward the above requirement.
- (b) Thesis research courses
Each Ph.D. student must register for the relevant Thesis Research Course in every term throughout his/her study period. A written report is required to submit at the end of each term.
- Full-time Ph.D. (post-candidacy) students: MAE812R
 - Part-time Ph.D. (post-candidacy) students: MAE806R
 - Continuing Ph.D. (post-candidacy) students: MAE803R

2. *Other Requirements:*

- (a) Students are required to submit a research thesis and pass an oral examination for graduation.
- (b) IT Proficiency Test. (Please refer to “Student IT Competence”).
- (c) Students must carry out a substantial amount of research, leading to original results worthy of publication in scholarly journals.
- (d) Complete an Improving Postgraduate Learning (IPL) module on “Observing Intellectual Property and Copyright Law during Research”. This will be an online module and relevant information can be accessed from the website: www.cuhk.edu.hk/clear/programmes/programmes.htm.
- (e) Students are required to attend IPL modules on “General Safety”. Students should consult Division for details.

II. **Ph.D. Programme in Automation and Computer-Aided Engineering (Full-time and Part-time); and**

(Applicable to students admitted in 2006-07 and before)

III. **Ph.D. Programme in Mechanical and Automation Engineering (Full-time and Part-time)**

(Applicable to students admitted in 2007-08)

1. *Coursework Requirement*

- (a) Each Ph.D. student is required to complete at least two graduate courses (with a total of 6 units) at code 5000 level or above related to their research as recommended by the thesis supervisor with the approval of the Division Head. Undergraduate courses (coded 4xxx or below) cannot be used to fulfill this requirement.
- (b) Students must achieve no lower than grade “B-” in each of the courses taken that count toward the above requirement.
- (c) Students are required to take MAE9xxT every term from the time of admission, throughout the preparation of thesis, until its completion.

First Year of Attendance

1st term: MAE901T

2nd term: MAE902T

Third Year of Attendance

1st term: MAE905T

Second Year of Attendance

1st term: MAE903T

2nd term: MAE904T

Fourth Year of Attendance

1st term: MAE907T

2nd term: MAE906T

Fifth Year of Attendance

1st term: MAE909T

2nd term: MAE910T

Seventh Year of Attendance

1st term: MAE913T

2nd term: MAE914T

2nd term: MAE908T

Sixth Year of Attendance

1st term: MAE911T

2nd term: MAE912T

Eighth Year of Attendance

1st term: MAE915T

2nd term: MAE916T

For students admitted in the 2nd term (i.e. January), the sequence of required courses MAE9xxT should be the same.

2. *Comprehensive/Qualifying Examination*

Students are required to pass a departmental qualifying examination.

- (a) Qualifying examination (QE) will be administered at least twice a year.
- (b) Students are required to take the QE before the following specified period after enrolling in the Ph.D. programme:
 - i) no later than 18 months for full-time students; or
 - ii) no later than 30 months for part-time students.
- (c) The QE includes a written part and an oral part.
- (d) The written part consists of problems in designated areas of the Division. The student is required to answer a required number of questions. A mandatory technical writing part is also included.
- (e) The oral part includes a presentation on the student's thesis proposal, followed by a period of questioning from a Committee appointed by the Division.
- (f) Based on the student's performance in the written part, the quality of the thesis proposal, and the student's demonstrated abilities in pursuing the proposed research, the Committee makes a recommendation to the Division: Pass or Fail.
- (g) For student with a Fail grade, the Committee also decides one of the following options for him/her:
 - i) take QE (or part of it) again the immediate next time; or
 - ii) switch to M.Phil. programme.
- (h) A student is required to discontinue from his/her Ph.D. study if he/she fails to achieve a Pass grade after two attempts in the QE.

3. *Other Requirements*

- (a) Students are required to submit a research thesis and pass an oral examination for graduation.
- (b) IT Proficiency Test. (Please refer to "Student IT Competence".)
- (c) Students must carry out a substantial amount of research, leading to original results worthy of publication in scholarly journals.
- (d) Complete an Improving Postgraduate Learning (IPL) module on "Observing Intellectual Property and Copyright Law during Research". This will be an online module and relevant information can be accessed from the website: www.cuhk.edu.hk/clear/programmes/programmes.htm.
- (e) Students are required to attend IPL modules on "General Safety". Students should consult the Division for details.

IV. **M.Phil. Programme in Automation and Computer-Aided Engineering (Full-time); and**

(Applicable to students admitted in 2006-07 and before)

V. **M.Phil. Programme in Mechanical and Automation Engineering (Full-time)**

(Applicable to students admitted in 2007-08)

1. *Coursework Requirement*

- (a) Each M.Phil. student is required to complete at least four graduate courses (with a total of 12 units) at code 5000 level or above related to their research as recommended by the thesis supervisor with the approval of the Division Head. Undergraduate courses (coded 4xxx or below) cannot be used to fulfill this requirement.
- (b) Students must achieve an average grade no lower than “B-” in each of the courses taken that count toward the above requirement.
- (c) Students are required to take MAE8xxT every term from the time of admission, throughout the preparation of thesis, until its completion.

First Year of Attendance

1st term: MAE801T

2nd term: MAE802T

Third Year of Attendance

1st term: MAE805T

2nd term: MAE806T

Fifth Year of Attendance

1st term: MAE809T

2nd term: MAE810T

For students admitted in the 2nd term (i.e. January), the sequence of required courses MAE8xxT should be the same.

Second Year of Attendance

1st term: MAE803T

2nd term: MAE804T

Fourth Year of Attendance

1st term: MAE807T

2nd term: MAE808T

2. *Other Requirements*

- (a) Students are required to submit a research thesis and pass an oral examination for graduation.
- (b) IT Proficiency Test. (Please refer to “Student IT Competence”.)
- (c) Complete an Improving Postgraduate Learning (IPL) module on “Observing Intellectual Property and Copyright Law during Research”. This will be an online module and relevant information can be accessed from the website: www.cuhk.edu.hk/clear/programmes/programmes.htm.
- (d) Students are required to attend IPL modules on “General Safety”. Students should consult the Division for details.