
A GUIDE TO THE ENGINEERING TRIPOS: PARTS IA and IB 2011/2012

NB Throughout this document the word “week” refers to Thursday to Wednesday of the normal teaching term.

Note that this document is updated each year. Students in Part IB should check the version posted on the Undergraduate Teaching Webpages for details, e.g. laboratory mark schemes.

INTRODUCTION

The Engineering Tripos comprises a two-year Part I followed by a two-year Part II. All CUED undergraduates study the same subjects for their first five terms. There is an element of choice in the sixth term, and in their third and fourth years students specialise in a chosen engineering area.

The aims of Part I of the Engineering Tripos are to encourage and enable students:

- To develop a sound understanding of the fundamentals of engineering science across a broad range of engineering disciplines;
- To acquire basic skills in modelling and analysis and the ability to solve straightforward technical problems;
- To acquire basic design skills and the ability to create simple engineering designs using a multi-disciplinary approach;
- To develop an awareness of the responsibilities of engineers in economic, social and environmental matters, and the international role of the engineer;
- To develop practical skills and the ability to conduct and evaluate experiments;
- To create, use and evaluate computer software;
- To develop communication skills, both oral and written;
- To develop co-operative skills through group and teamwork activities;
- To acquire basic study skills, and to develop independence of learning;
- To develop a responsible and professional attitude.

PART IA

Lectures are timetabled throughout the Michaelmas and Lent terms, and the first four weeks of the Easter term.

Lecture courses examined in Part IA

All students take the same four 3-hour examinations at the end of their first year. These are:

Paper 1	Mechanical Engineering	Mechanics (16 Lectures) Mechanical vibrations (12 Lectures) Thermofluid mechanics (24 Lectures)
Paper 2	Structures & Materials	Structural mechanics (24 Lectures) Materials (20 Lectures)
Paper 3	Electrical & Information Engineering	Physical principles of Electronics, Electromagnetics (12 Lectures) Linear circuits and devices, AC power (22 Lectures) Digital circuits and information processing (16 Lectures)
Paper 4	Mathematical Methods	Mathematics (40 or 32 Lectures) (<i>depending on previous experience</i>) Computing (8 Lectures)

One Example Paper is issued for about every four lectures listed above. Example Classes and College Supervision are arranged on these topics.

Engineering Applications (8L)

These sessions are opportunities to illustrate the applications of engineering principles in the widest possible context over a broad range of technologies.

Coursework

Important engineering skills are developed in a wide variety of coursework exercises. The Michaelmas term involves various induction activities which lay the foundations for engineering skills developed throughout the course. An outline of the coursework activities in Part I of the Engineering Tripos is given in [Table 1](#), together with the number of timetabled sessions allocated to them.

IA Coursework starts with an intensive, hands-on activity using **Lego Mindstorms**. For the first week, students work in groups of three to design and build a simple electro-mechanical device, based around a number of sensors and actuators. The exercise is open-ended and fun, giving an immediate awareness of the integrated nature of real-world engineering, involving software, mechanical and electrical components, teamwork, and communication skills. All groups present their devices, with prizes for the best systems, demonstrated to the whole year at the end of week 2.

Each timetabled **Drawing** session, both morning and afternoon, begins with a lecture. The Michaelmas term exercises introduce the basic principles of projection theory. The interpretation and making of mechanical drawings, including CAD, are practised in the Lent and Easter terms.

The communication of technical information is developed through the **Exposition Course** which aims to improve students' presentation, discussion and writing skills. Students' laboratory reports on the **Statics Experiment** are critically reviewed during these sessions. In addition, each student is required to give a short (10-15 minute) talk on technical material and to take part in a debate on a current technical topic, or other appropriate activity. The topics chosen are at the discretion of the group leader. The good practice initiated during the Exposition exercises is developed throughout the course, whenever students write laboratory or project reports, essays or give oral presentations on their project work.

Eight lectures are given on the **Engineer in Society**, in which the wider issues that influence technical decision making are discussed. Students' assimilation of the lecture material and their reading around the subject is assessed through a report. There are also eight lectures on the **Principles of Design**, assessed through the **Product Design Project**. The principles of **Dimensional Analysis** are covered in four lectures at the start of term followed by two experiments (and questions may be set on this topic in the Part IA examinations). **Note: Attendance at all these lectures is necessary for students to complete their coursework satisfactorily.**

The Michaelmas term **Computing** course starts with an introductory lecture for all students. Subsequent practical work provides an introduction to the system and the basic elements of the C++ programming language. The first practical session for each group of students will start with a short optional briefing session for those who are inexperienced in computing. Lectures for all students (weeks 7-8 Michaelmas and 1-2 Lent) reinforce the preceding practical work and introduce new material, some of which is needed to complete the second part of the practical work. The Lent term computing practicals place emphasis on design and problem solving. The computing course is examined in Paper 4 Mathematical methods. An open-ended long vacation exercise (the "Mars lander") aims to keep computing skills fresh for Part IB. **Microprocessors** are introduced through a series of labs in the Easter term, learning how to program them, and producing and testing a temperature-control program.

Creative thinking and synthesis are fostered in design projects. All students undertake a **Structural Design Project**. Working in pairs, they design, manufacture and test a metal structure to carry given loads at minimum cost. The structures are tested to destruction in ascending order of 'cost'. After the test, recommendations are made on how the design might be improved. Assessment is by the quality of the tested product, the quality of the drawings and the individual reports. In the **Integrated Electrical Project**, students work in pairs to design, build and test an AM radio. This project brings together design software and working with electrical components to integrate many topics in the lecture courses on linear circuits and electronics. The students' assimilation of the material covered in the eight lectures on the principles of design is tested through a **Product Design Project** where they are asked to design a device to meet a specified need.

Students undertake 13 **experiments** during the Lent term and the first three weeks of the Easter term. The topics on which these experiments are based are listed in [Table 2](#). Some experiments are 'short'. These straightforward experiments aim to give students experience of important techniques and phenomena. Each task is completed and signed up in the two-hour morning period assigned to it. 'Long' experiments normally require two hours in the laboratory to complete the investigation and record the results, with an extra two hours on writing-up and drawing conclusions, and a subsequent sign-up session.

Students are encouraged to study a **foreign language** in their spare time during the first two years of the Tripos. The [Language Programme for Engineers](#) offers courses in French, German, Spanish, Japanese and Chinese at advanced, intermediate and beginner's level. Students may submit coursework in a foreign language for credit in the Part IB examination (see next section). Coursework may include oral and written tests.

PART IB

Lecture courses examined in Part IB of the Tripos

Each of the 8 papers in Part IB is taken by all students. Papers 1-7 are of 2 hours' duration. Paper 8 is of 2.5 hours' duration, except for those students submitting coursework in one foreign language, where it is of 1.5 hours' duration. The papers are:

Paper 1	Mechanics (16L)	
Paper 2	Structures (20L)	
Paper 3	Materials (16L)	
Paper 4	Thermofluid Mechanics (26L)	
Paper 5	Electrical Engineering:	Linear circuits and devices (10L) Electrical machines (10L) Electromagnetic fields and waves (6L)
Paper 6	Information Engineering:	Linear systems and control (14L) Signal & data analysis (7L) Communications (7L)
Paper 7	Mathematical Methods:	Vector calculus (14L) Linear algebra (8L) Probability (6L)
Paper 8	Selected Topics Compulsory section:	Business economics (8L)
	Electives (14L):	(i) Civil & structural engineering (ii) Mechanics, materials and design (iii) Aerothermal engineering (iv) Electrical engineering (v) Information engineering (vi) Engineering for the life sciences (vii) Manufacturing, management and design

All lectures for **Papers 1-7** are scheduled during the Michaelmas and Lent terms, and have associated experimental work, and Example Classes. Colleges arrange supervisions on these topics.

Paper 8 consists of engineering activities taught in the context of design, and is divided into seven electives with the topics shown below. Students not submitting coursework in a foreign language are required to answer questions from two electives. Students who are submitting coursework in a foreign language are required to answer questions from one elective. The material in the electives is not considered prerequisite for third year courses (although some preliminary reading may be expected by those who have not taken a particular elective). In addition, **all** students are required to answer one question from the compulsory section on Business Economics, lectures for which are given in the Michaelmas term. Lectures for all the other sections are given during the first four weeks of the Easter term. There are two Examples Papers per elective, for which fully worked solutions are available to students and Examples Classes included in the lectures. Colleges do not arrange supervisions for Paper 8.

The engineering elective topics are:

(i) Civil & structural engineering:	Design and Construction of Underground Space
(ii) Mechanics, materials and design:	Mechanical Engineering for Renewable Energy
(iii) Aerothermal engineering:	Design of a Jet Engine
(iv) Electrical engineering:	Micro- and Nano-electronic Devices
(v) Information engineering:	Photo Editing and Image Searching
(vi) Engineering for the life sciences:	Engineering of the Human Eye
(vii) Manufacturing, management and design:	Bringing Technology Innovations to Market

Coursework

An outline of the coursework activities in Part IB is given in [Table 1](#), together with the timetabled sessions allocated to them.

All students undertake 20 **experiments**, as listed in [Table 2](#). There is a mixture of long and short experiments. An **Integrated Coursework** activity links 4 of the short labs (in vibration, structures, soils and signal processing) together round the common topic of “earthquake-resistant structures”, with students choosing one extension activity to pursue in more depth, leading to a report and presentation.

The Michaelmas term **Computing** course provides an introduction to Octave/Matlab. Four practical sessions are timetabled, covering the Matlab language and environment, and students undertake exercises to display data and solve various numerical problems. The Lent term **Computing** course consists of four programming exercises which reinforce the C++ programming skills introduced in the Part IA computing course.

Students work in teams of six to design, build and test a mobile robot vehicle as an **Integrated Design Project (IDP)**. Various tasks, typical of those faced by the automated guided vehicles used in modern manufacturing plants, are set for the vehicles. Each team member is individually responsible for a particular sub-system, e.g. structure and drive train, power supply, sensors, electronic control or software integration, as well as contributing to the overall system design and optimisation. The project builds on Part IA teaching in electronics, computing, mechanics and structures, and aims to develop teamwork and communication skills. Students spend three two-hour sessions for four weeks working on this project. The resulting vehicles are tested in a competition to determine the best. Assessment is by quality of the robot vehicle and of team, sub-team and individual reports.

In the Lent term, a series of 5 lectures presents contemporary applications of the different disciplines to **Sustainable Engineering**, assessed through a poster on a topic selected by the student, prepared over the Easter vacation.

TABLE 1 - COURSEWORK

Year	Term	Coursework	No. of timetabled 2-hour (morning) Lab Sessions + afternoons
First Year (IA)	Michaelmas	Lego Mindstorms Dimensional Analysis Statics experiment Exposition Computing	5 in total (2 or 3 in afternoons) 2 1 8 2 ¹ + 2 afternoons
	Christmas Vacation	Report on 'The Engineer in Society'	
	Michaelmas, Lent and Easter	Drawing Structural Design Project Integrated Electrical Project	8 ² + 8 ² afternoons 5 ³ + 5 ⁴ afternoons 4 + 3 afternoons
	Lent and Easter	Microprocessors Computing Experiments	3 2 ¹ + 2 afternoons 13 ⁵
	Easter Vacation	Product Design Project	
Second Year (IB)	Michaelmas and Lent	Experiments Computing Integrated Coursework ⁷ Integrated Design Project ⁷	16 ⁵ 8 ⁶ 5 ¹ + 2 morning/afternoon 13 ¹ + 1 afternoon lecture
	Easter Vacation	Poster on 'Sustainable Engineering'	

Notes:

- ¹ Including a lecture/briefing at the first session.
- ² Including a short lecture at the beginning of each session.
- ³ Plus one report feedback session.
- ⁴ Fixed consecutive afternoons for workshop fabrication.
- ⁵ Plus signing-up periods for long experiments.
- ⁶ Four in Michaelmas term, four in Lent term.
- ⁷ Each student will do one of these activities in the Michaelmas term and the other in the Lent term.

TABLE 2 - EXPERIMENTS**Part IA: 13 Experiments (Lent/Easter terms)**

Associated Paper	Experiment Number and Title	Long or Short
Mechanics:	1. Kinematics of plane mechanism	L
	7. Vibration	S
	8. Energy and power	S
Thermofluids:	2. Gas engine	L
	9. Turbocharger	S
	10. Inviscid fluid flow	S
Structures:	3. Elastic beams	L
Materials:	4. Plasticity and fracture	L
	11. Non-destructive testing	S
Electrical and Information:	12. Iron-cored transformer	S
	13. AC Power	S
	14. Combinational logic	S
	15. Sequential logic, memory and counting	S

Part IB: 20 Experiments (Michaelmas/Lent terms)

Associated Paper	Experiment Number and Title	Long or Short
Integrated Coursework: (inter-disciplinary)	A1. Dynamic vibration absorber	S
	A2. Model structures	S
	A3. Soil mechanics	S
	A4. Fourier signal analysis	S
Mechanics:	D1. Rotor dynamics	S
Structures:	S1. Plastic collapse	S
Materials:	M1. Materials characterisation	L
	M2. Heat treatment	S
	M3. Torsion testing	L
Thermofluid mechanics:	T1. Peltier heat pump	S
	T2. Pipe-flow	S
	T3. Boundary layers	L
	T4. Heat transfer	S
Electrical engineering:	E1. Power amplifier	S
	E2. Synchronous machine	S
	E3. Induction motor	S
	E4. Wave transmission	L
Information engineering:	I1. Spectrum analysis	L
	I2. Process control	S
	I3. Position control	S

COURSEWORK CREDIT

All Part I coursework is for *standard credit*, which means that once students achieve a satisfactory standard in the various groups of activities, the associated marks are capped at the qualifying level. Candidates who fail to reach the qualifying marks will be penalised by the examiners.

The marking schemes are attached in Appendix A: [Coursework for Part IA of the Engineering Tripos](#) and Appendix B: [Coursework for Part IB of the Engineering Tripos](#).

The standard credit scheme has been designed to encourage students to attend coursework sessions punctually, to complete each laboratory-based activity within an appropriate time to a satisfactory standard so as to achieve the main objectives of the activity, and to submit any written work for marking within a specified timescale. The system aims to help students by discouraging them from spending an inordinately long time on any one coursework activity, at the expense of other aspects of their study. It also encourages innovation in design work, as there is not an undue loss of marks for a less successful outcome.

REARRANGING COURSEWORK AND ALLOWANCES FOR ILLNESS

Students are expected to undertake all the coursework as specified above. The [Guidelines for Rearranging Coursework](#) on the Teaching Webpages summarise acceptable reasons to request a change in coursework arrangements. Students should contact the member of staff in charge of the activity *as soon as possible*.

If coursework activities or deadlines are missed due to illness or other grave cause, you are expected to make all reasonable efforts to complete missed sessions at a later date, applying for an extension to deadlines as necessary. If it is impossible to complete the activity, an allowance of marks may be made – details are provided in the [Allowances for Illness](#) notes (on the Teaching Webpages, or available from the Teaching Office). All requests for extensions or mark allowances must be made to the Director of Undergraduate Education at the first opportunity after the work is disrupted. Applications must be made by students via their college Tutors on the Departmental [Allowances for Illness form](#), available from the Teaching Webpages or the Teaching Office.

COOPERATION / CHEATING

Coursework marks contribute significantly to your overall Tripos mark. Because this work is not carried out under examination conditions, the distinction between beneficial co-operation and deliberate cheating should be clearly understood.

Co-operation: It is perfectly acceptable to discuss continuously-assessed work with other students, or with demonstrators or supervisors. Such discussions are beneficial and are to be encouraged. It is right that effective use of such discussions can lead to higher marks, always provided that the student has made the main contribution to the work submitted and understands all of it.

Cheating: Co-operation can go too far, however, especially if one student is effectively carried by another or by the demonstrators. For example, while it may well be beneficial for students to discuss a problem in computing, it is unacceptable for two students to submit effectively identical programs. The named author must have made the main contribution to the work submitted and the report must be in his or her own words.

Any deliberate attempt to pass off the work of others as being produced by the named author is cheating. Students suspected to have cheated will be reported to the Director of Undergraduate Education, and interviewed by an appropriate member of staff. For each coursework submission found to have been copied in part or in whole a mark penalty will be imposed and the students' Director of Studies informed. Any appeal at this stage must be referred to the Head of the Department. The Examiners may be informed and might take further action. Serious cheating will be referred to the University Proctors, after which the Department has limited influence.

NB The range of penalties for cheating in University examinations and coursework includes disqualification from the BA and MEng degrees. Ignorance of the seriousness of plagiarism will not be an acceptable defence.