Part IA guide

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 Part II students specialise in a chosen engineering area.

NB. Throughout this guide 'week' refers to Thursday to Wednesday of the normal teaching term.

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Aims & objectives

Teaching aims

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;
- acquire basic skills in modelling and analysis and the ability to solve straightforward technical problems;
- acquire basic design skills and the ability to create simple engineering designs using a multi-disciplinary approach;
- develop an awareness of the responsibilities of engineers in economic, social and environmental matters;
- develop practical skills and the ability to conduct and evaluate experiments;
- learn to create, use and evaluate computer software;
- develop communication skills, both oral and written;
- develop cooperative skills through group and teamwork activities;
- acquire basic study skills and develop independence of learning;
- develop a responsible and professional attitude.

General objectives

At the end of the Part I course students should:

- by means of lecture courses, associated examples papers and appropriate reading have learnt the fundamental principles of engineering science;
- by means of laboratory courses have witnessed phenomena associated with the material in the lecture courses, have gained an understanding of experimental methods and have experience of experimental techniques;
- by means of practical computing courses be able to create and evaluate software;
- by means of projects have been introduced to research and design;
- by means of a course in exposition and subsequent practice have developed powers of presentation both orally and in writing;
- by means of lecture courses, occasional lectures, essay assignments and industrial experience have gained an introduction to manufacturing, management and the economic, environmental and social

responsibilities of engineers.

The progress of each undergraduate is measured by Tripos examinations and by assessed coursework. Tripos classes and details of marks are notified to undergraduates through CamSIS or by their Colleges, and progress with coursework is communicated by staff marking individual coursework activities.

Achievement of the general objectives is dependent on an undergraduate reaching detailed objectives set for individual activities of the course. These are listed in the syllabuses for each series of lectures and the instruction sheets for coursework.

Part IA structure

Lectures

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

All students take the same four 3-hour examinations at the end of their first year. These papers and the lecture courses examined in them 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)* Computing (2 lectures + coursework lectures)

*Note on the fast & standard mathematics courses

The Michaelmas term mathematics course is given in two different versions: a standard course (three lectures per week) and a fast course (two lectures per week). Both will cover the same syllabus, and will use the same examples papers.

The **fast course** is aimed primarily at those who have taken maths and further maths at A-level and have good mathematical fluency, so they may already have seen some of this material. The **standard course** aims to cater for those with less prior training in mathematics, especially those with only single mathematics A-level. The lecturers will endeavour to keep in step, so that it will be possible to swap courses for particular broad topics. Attend the first lecture which most suits your background, and the lecturer will explain the arrangements in more detail.

Engineering applications (8 lectures)

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

Examples papers

One examples paper is issued for about every four lectures, on Wednesdays according to the termly schedule. The

material is followed up in examples classes (see lecture timetable) and College supervisions. Solutions (cribs) of each examples paper will be made available to students online after the corresponding examples class.

Coursework

Important engineering skills are developed in a wide variety of coursework exercises. The Michaelmas term includes induction activities which lay foundations for the rest of the course.

Part IA coursework & labs overview

Introduction

Outlines of the Part IA coursework activities and experiments are given below, together with the number of timetabled sessions allocated to them.

Also see the general information about Part I labs & coursework.

Lego Mindstorms

Part 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.

There are ten timetabled hours in the lab & coursework schedule, but students may wish to allow extra time during the evenings and weekend. Team allocations will be posted on Moodle on Wednesday 7 October. The Lego lab handout (issued at the introductory lecture) includes instructions on how to sign on to Moodle. All students should do this, and browse the project documentation on the Moodle site, during the afternoon of Wednesday 7 October. All groups present their devices, with prizes for the best systems, demonstrated to the whole year at the end of week 2.

Drawing

Each timetabled drawing session, both morning and afternoon, begins with a lecture to outline the material that will be covered in the following practical class. 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.

Students are expected to attend both the lecture and the following practical class. Work set for each drawing class **must** be handed in at the end of each session. Students should avoid commitment to other afternoon activities on the one day a fortnight when they are scheduled to attend drawing classes (see the lab & coursework schedules). Supervisions should be timetabled to avoid afternoon lab sessions.

Most of the equipment required for the practical drawing sessions is provided. See additional course costs for details of the drawing equipment that students are expected to have.

Exposition

The communication of technical information is developed through the exposition course which aims to improve students' presentation, discussion and writing skills. Students' lab 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.

Engineer in society, principles of design, product design project and dimensional analysis

Eight lectures are given on the role of 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).

NB. Attendance at **all** these lectures is necessary for students to complete their coursework satisfactorily.

Computing and microprocessors

The computing course starts in each term with an introductory lecture for all students. Subsequent practical sessions in Michaelmas term provide an introduction to the system and the basic elements of the C++ programming language. The IA C++ coursework notes must be read before each practical session. Every session starts with a mini-lecture on the concepts to be developed in the hands-on time immediately afterwards. The Lent term computing practicals place emphasis on design and problem solving and also include initial briefings. Microprocessors and learning how to program them are introduced through a series of labs in the Easter term.

Students should avoid commitment to other afternoon activities on the days that they are scheduled to attend computing sessions (see the lab & coursework schedules). Supervisions should be timetabled to avoid afternoon lab sessions. 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.

Structural design project

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.

Integrated electrical project

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 project begins with a timetabled lecture for all students towards the end of Michaelmas term, and has a concentrated period of laboratory activity in the Lent Term.

Product design exercise

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. In addition to a brief report, students present their solutions in person to an audience which includes a designer from industry.

Outline of coursework activities

Term	Coursework	No. of timetabled 2-hour (morning) lab sessions + afternoons
Michaelmas	Lego Mindstorms Dimensional analysis Statics experiment Exposition Computing	5 (2 or 3 in afternoons) 2 1 8 3 + 3 afternoons
Christmas Vacation	Report on 'the engineer in society'	
Michaelmas, Lent and Easter	Drawing Structural design project Integrated electrical project	9 + 9 afternoons 5 + 5 afternoons 5 + 4 afternoons
Lent and Easter	Microprocessors Computing Experiments	2 + 1 afternoon 2 + 2 afternoons 13
Easter Vacation	Product design project	

Outline of experiments (Lent/Easter terms)

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 below. 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.

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

Coursework credit

Coursework in Engineering includes lab work and projects, plus a number of other marked assignments.

Coursework for standard credit at Part I

In Parts IA and IB, all 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. Students who fail to reach the qualifying marks, or who fail to attend or hand in certain coursework, will have the shortfall deducted from their total in the Tripos. The marks available and qualifying marks are shown in the Faculty Board Part IA and Part IB coursework credit notices.

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.

The majority of students are expected to gain the qualifying standard.

Part I labs & coursework: general info

General guidelines

- **Charts** in the individual lab expand the lab/coursework schedule into particular activities. Check beforehand that you know the location of your next exercise.
- **Penalties** apply for students arriving late to labs.
- Be aware of the procedure for **rearranging** missed coursework sessions.
- Read the note on **safety** and observe any special instructions on safety in individual labs. You should bring safety glasses, issued at the start of the year, for all materials labs (in the Lent and Easter terms) and for the structural design course practical work. You may be excluded from labs if you do not bring them.
- Students are advised to read the handout for the experiment online before attending the lab session. Printed copies of the handout will be available at the start of each lab.
- For much of the Part I lab work in the Lent and Easter terms you will need to use your **lab book** for recording data and taking notes during laboratory experiments. You are encouraged to word-process lab reports, which should be glued or stapled into your lab book.
- Experiments are classified as either **short** or **long**:
    - A short experiment occupies on 2-hour period and is completed and signed-up in that time.
    - A long experiment occupies 2 hours in the lab and is then written up as a report.
- Any urgent **problems** with an experiment or exercise should be reported to a demonstrator or the lab leader in charge of the laboratory.
- The report for each long lab should be set out in the lab notebook provided at the start of the year. Your report, together with that of your partner, will be **marked** by a demonstrator at a signing session. This must take place within 15 days of the date of the experiment.
- **Signing** sessions should be booked during the blank periods on the lab schedule. Demonstrators will give guidance on the form and content of the report expected for a particular experiment. It is important that you bring your lab notebook with you to each long experiment.
- **Credit** for the satisfactory performance of a short experiment is 2 marks. Credit for a long experiment is on the scale 0-6, with 4 marks for completion of the experiment and minimally acceptable work, 5 marks for satisfactory work and 6 for exceptional work. Late submission of a report incurs a deduction of 1 mark for each week, or part of a week, after the due date.

See the guidance on lab start times and allowances.

The lab record and long report

It is essential that you bring your lab notebook with you whenever you are timetabled to perform a long experiment. The notebook should be used to record all the readings, observations and calculations that you make, unless the instruction sheet specifically states otherwise. Do not use loose sheets of paper: these are easily misplaced. Charts and other records should be glued or stapled into your notebook.

Your lab record should start on a new page for each experiment performed. It should follow good professional practice and be correctly headed and dated. When there are several readings to enter, arrange these in tabular form, and make sure that the column headings show the quantity measured and the units used. Decide on how many columns you need and set out the table before you start taking readings. Whenever feasible, plot graphs as the experiment proceeds so that serious divergence from the expected behaviour can be checked there and then. Label the axes of the graphs and, where appropriate, indicate the accuracy of the data points on the graph.

The "report writing guide" covers all aspects of report writing in the Engineering Tripos. Specific sections are introduced via IA Exposition classes. For experiments and reports in Part I, you are referred in particular to the following sections:

- Report writing in the Engineering Tripos: long lab records and reports
- Introduction to technical writing: integrity, record-keeping, plagiarism and referencing

Difficulties with the lab report

If you need advice on a particular aspect of your report or you are otherwise held up on some point, then seek help. You can obtain help from a demonstrator in the laboratory or your supervisor. Do this in good time and you will not be rushed into producing an unsatisfactory report.

Copying the work of others is unacceptable. However, discussing your work with colleagues, supervisors or demonstrators is encouraged and can bring about improvements to the standard of the report you submit. The report itself must be your work, written in your own words. Students who submit the work of others as their own will have their reports referred to the appropriate authorities.

Feedback on labs & experiments

If you have comments about any experiment, please tell us about them using the fast feedback facility. Urgent problems with an experiment should be reported immediately to a demonstrator or senior technician in the lab, or contact the member of staff in charge of the lab. Please be constructive in your comments and suggestions.

Finally please complete the coursework section of the online survey during the year.

Rearranging coursework & allowances: general rules

Introduction

The Faculty Board of Engineering has issued the following guidelines about the circumstances under which coursework activities may be rearranged or allowances granted. The Head of Department delegates all the responsibilities mentioned in this document to the Director of Undergraduate Education. All forms are processed via the Teaching Office.

In Parts IA and IB students' coursework assignments are set by the lab rotas issued by the Teaching Office. In Parts IIA and IIB students are to a great extent responsible for setting their own coursework timetables by signing up for lab experiments etc. associated with the modules they are doing.

Main rules

1. Students should make **all reasonable efforts** to complete any missed exercises at a later date and so must first try and make rearrangements with the lab leader.
2. Applications should be made at the time rearrangement proves not to be possible, and at latest by the end of the relevant term.
3. Any application for an allowance must be made on the **standard form**. This form must be completed in full by both student and Tutor. The Tutor may be required to submit supporting medical evidence (e.g. if the period affected is over 7 days).
4. Forms should be submitted as soon as it is clear that an allowance may be required. **No forms will be accepted after the deadlines.**
5. A total allowance of more than four weeks coursework will not normally be given, in any year.

Types of allowance

The granting of an allowance implies either:

1. an **extension** of the scheduled period for completion and submission of an activity (applicable to both standard credit and positive credit activities); or
2. the **allocation of a number of marks** for the activity missed, if it proves impossible to rearrange or catch up the activity. For standard credit activities, the mark allocated will normally be the qualifying mark for the activity. For positive credit exercises, any mark allocated will depend upon the student's performance in related assessed activities.

In all cases, the Director of Undergraduate Education will consider the allowance form submitted by the student and Tutor, and decide upon the type and extent of any allowance to be made. These are incorporated in the final coursework marks sent to the Chairmen of Examiners. The Teaching Office will notify the Tutor and the student of the outcome of any application.

Allowances for individual activities are described in more detail for each Part:

- Parts IA and IB
- Part IIA
- Part IIB
- MET Parts IIA and IIB

Reasons for arranging coursework

Reasons for seeking to rearrange course work fall into one of the following five categories:

Illness

Educationally it is always preferable to rearrange coursework missed through illness, and this should be attempted wherever practicable. If rearrangement is not possible, then students should apply for the appropriate allowance.

‘Illness’ is defined as any illness, injury or other grave cause which, in the opinion of both the student's tutor and the Director of Undergraduate Education, prevents the student from completing their scheduled coursework activities on time, or in some cases at all.

Compassionate or religious grounds

Students will, wherever practicable, be allowed to rearrange coursework on compassionate or religious grounds (for instance, to enable them to attend a funeral, or because the coursework is scheduled on the day of a religious festival). The student concerned should try to rearrange the coursework in advance. If rearrangement proves impossible, then an application for an allowance may be made with the support of the student's tutor.

Interviews

When applying for jobs, work placements or sponsorship, students may be invited for interview on days that conflict with coursework activities. Students should in the first instance seek to rearrange the interview rather than the coursework. If this proves impossible, then the student should try to rearrange the coursework. Allowances are not normally given for coursework missed through interviews.

Sporting commitments

Coursework may **not** be rearranged to accommodate **College** sporting commitments. Students will, wherever practicable, be allowed to rearrange coursework that conflicts with **University** sporting competitions (i.e. representing the University of Cambridge in a competitive event) but not for training sessions.

NB. Allowances are not normally available if such rearrangement is possible.

Other reasons

If a student wishes to seek to rearrange coursework for any reason not covered by the four categories above, they should discuss the matter with the Director of Undergraduate Education.

How to rearrange coursework

Part I coursework

For Part I coursework (including sign-up sessions) students should identify an appropriate replacement slot in the timetable, in discussion with the appropriate chief technician, and then clear this with the lab leader in charge of the activity.

Part II coursework

For Part II coursework, students should contact the staff member in charge of the coursework activity (e.g. lab/EAA leader or module leader). Wherever possible, arrangements should be made in advance – failure to do so when the need for rearrangement was foreseeable may result in the request being refused. In some cases, it may be necessary to apply for an extension to a deadline to allow coursework to be completed.

Distinguishing between 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 cooperation and deliberate cheating should be clearly understood.

The following information applies to **all students**. There is also supplementary information for Part IIB students.

Cooperation

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. 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

Cooperation 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.

Electronic exchange of lab work is likewise acceptable up to a point. Results obtained jointly in the lab may have only been recorded by one student in a pair, due to time constraints, and it may be more practical to pass these on in electronic format (e.g. for a word-processed report). But analysis of the data, or production of graphs for the write-up, and all written sections of the report **must** be done individually, and may not be exchanged electronically.

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 even partially copied, a mark penalty will be imposed and the student's Director of Studies informed. The examiners may be informed and might take further action. Serious cheating will be referred to the University proctors.

Inclusive teaching

The Equality Act (2010) requires higher education institutions to take positive steps to make their education accessible to disabled students and to make 'reasonable adjustments' to provision to ensure that disabled students are not disadvantaged. Disabilities may include physical or mental impairments: the majority of these students have specific learning difficulty (SpLD) in the form of dyslexia. Cambridge University Disability Resource Centre has some standard recommendations for appropriate academic support for such students. Further provision may be required in particular cases.

In an organisation of our size and complexity, individual variations in provision are potentially disruptive. However, many of the suggested adjustments are just good educational practice, so represent things we should be doing anyway as a Department that takes pride in the excellence of its teaching. Indeed, we already follow many of the recommendations (e.g. provision of cribs). The approach we have adopted is therefore to aim to have inclusive standard procedures for all teaching activities. Students are expected to make use of available resources to suit their needs, and to contact staff themselves (e.g. lecturers, lab leaders) if additional material is required.

Link to list of IA lecturers, IB lecturers and lab leaders for IA and IB.

Contact details of part II lecturers can be found on the relevant syllabus pages.

Any enquiries should be addressed to the CUED Director of Undergraduate Education.

The following recommendations have been agreed by the Faculty Board (12 November 2012):

- Electronic versions of handouts should be made available on-line 24h in advance of lectures or other teaching sessions (e.g. labs). [This allows students who do have special requirements to produce their own customised hard copy if they wish: e.g. single-sided; large format; non-white background].
- Filled-in versions of notes should be made available on-line after lectures.
- Recording lectures (audio) is often recommended to students as a learning aid. They must sign an agreement to use the recording only for their own personal study, and acknowledging IP and copyright. The agreement form can be found here, and students are asked to provide the Teaching Office with a copy. Lecturers are asked to consent to their lectures being recorded under these conditions. A list of students who have completed agreement forms can be made available on request.
- In labs, instruction should be provided in both written and verbal form.

- Lecturers should remember to pay attention to ‘signposting’ e.g. statement a start of each lecture of what is being covered; tracking progression throughout lecture; summary of main teaching points at end.
- All staff should make particular effort to put new vocabulary into context and explain new concepts. It is helpful to provide some repetition.