

Part I Review: update for the Department and its Alumni

This update consists of three parts:

1. a list of guiding principles for the Review;
2. the findings of the Department-wide consultation in Lent Term 2019;
3. a proposed attribute list for graduates of the revised course (for comment).

1. Guiding principles for the Review

The Part I Review Working Group and the Faculty Board have agreed the following guiding principles:

- we should follow good practice in course design by defining learning outcomes at an early stage and deriving appropriate teaching & learning activities and assessment methods from these learning outcomes;
- all courses should be designed to be inclusive of student and staff diversity, including the legally protected characteristics (e.g. age, disability, gender reassignment, marriage or civil partnership, pregnancy and maternity, race, religion or belief, sex, sexual orientation);
- all proposals should be site-independent: able to be delivered in Trumpington Street, on a split-site or in West Cambridge. Proposals should be considered for their potential to ease the move to West Cambridge;
- the proposals should be designed to make effective use of academic resource by adding value to learning;
- the total workload for staff and students should be reduced where possible and not increased;
- all proposals should be cost-neutral to Colleges;
- Part I should be seen as an educational foundation course for all the disciplines (assuming that we continue to offer a degree classified as “General Engineering”).

2. Findings of the Part I Review consultation in Lent Term 2019

Preface

This discussion paper summarises the main findings of the consultation exercise carried out by the Part I Review Working Group in Lent Term 2019. The consultation included:

- an Open Forum, which all staff and students were invited to join;
- discussions at the Subject Groups;
- numerous one on one conversations with colleagues;
- an online survey which was circulated to all staff.

The findings presented in this document, some of which are potentially contradictory, are not intended as recommendations but rather as a starting point for further discussions with staff, students, alumni and other stakeholders.

Multidisciplinarity and integration

Most of the survey responses from academics recommended that the strong emphasis on engineering science should be maintained to continue to provide both depth and breadth. Although the current course is broad in its coverage it is felt that there are many missed opportunities for multidisciplinarity and integration. Many responses highlighted the need to break silos between disciplines in Part I. It is therefore proposed that core Part I courses should focus on engineering science which is relevant to several engineering disciplines.

Balance between ‘engineering science’ and ‘engineering practice’

Preliminary consultations with industry and alumni resulted in conflicting advice regarding the balance between theory and practice. Some recommended a greater focus on developing engineering practice-related skills and less on scientific content, in accordance with recent trends in engineering education. Others indicated that they would prefer graduates to be equipped with a thorough grounding in engineering science which is difficult to acquire later, whereas the more practice-related skills can be developed as part of CPD. We have to strike the right balance, being aware of the needs of our graduates and where our strengths lie, i.e.:

- CUED is an international renowned, research-intensive institution;
- our students have the capacity to (and often expect to) engage with challenging technical and theoretical content.

In addition to the traditional expectations of engineering degrees (which we already broadly cover to meet accreditation criteria), we should aim to provide students with the intellectual skills to lead technological developments in certain areas, and to engage with engineering research in academia or industry.

Respondents suggested that given the limited time that students spend in Cambridge the Department’s teaching and learning activities should focus on technical skills, communication, creativity and, to some extent, innovation. Professional skills which are more specific to engineering practice (e.g. the use of particular software packages) may be further developed through industrial placements and/or engineering student teams, with the learning associated with these activities more clearly articulated.

The consultation identified that design and creativity in particular should gain more recognition. In this context creativity is not limited to designing products; one could also be creative and innovative when contributing to the development of science and technology, management or entrepreneurship. We should keep an open mind and promote creative thinking across all activities.

Management and entrepreneurship may be introduced as part of the course (taught for instance with JBS), but are best experienced elsewhere. However, we need to identify the bodies taking responsibility for these learning objectives. For example: internships and industrial experience, working with student societies, mentoring schemes, and further professional development in industry after graduation.

More focus on responsibility, ethics and important societal engineering challenges

Several staff members felt very strongly that the course should provide students with the relevant knowledge to tackle current and future engineering challenges, in particular with regard to issues that have high societal relevance (e.g. climate change and sustainability). A new Part I should provide more opportunities for students to learn about engineering science and innovation in the context of the UN’s Sustainable Development Goals. This would allow us to raise ethical considerations and professional values such as responsibility as part of the course.

Another important aspect of today’s challenges is their multidisciplinary nature and scale. Communication across disciplines and cultures is fundamental. We are privileged to have a very diverse cohort of students; we should acknowledge and nurture this diversity and make sure that students develop inclusive working practices during their project experiences.

Critical thinking and decision making in the presence of uncertainty are also skills to develop in the course. These might be developed for instance in the context of data science and statistics, as well as ethics and social responsibility.

Choice

The course is already very rich in content, especially in Part I. Although there is general agreement that the course should remain multidisciplinary a number of people recommended introducing some element of choice to enable students to explore in greater depth applications of the course in a subset of the engineering areas.

This could be achieved by cutting the number of hours of the general course and extending Paper 8 (e.g. to start in Lent Term). Coursework could also offer a choice between different flavours of a particular lab, for instance between computational/theoretical extensions of the work or others which are more oriented towards practice.

It would be good to offer students a broader spectrum of engineering practice experiences as part of the course, exploiting opportunities within the Department, as part of student societies and beyond. Potentially we could create opportunities for Part II students to experience leadership by mentoring Part I students in some activities. We could also establish more opportunities for students to interact with research during their studies (e.g. via buddy schemes and extension activities etc).

Self-learning

A significant proportion of the responses highlighted the need to promote self-learning in Part I. The ability to learn independently, and plan such learning, is key to engaging successfully with Part II and is an important skill. We should provide more opportunities for students to work autonomously, e.g. by developing self-learning material in Part I which covers both academic ("Teach yourself ...") and practical content (similar to that which has been introduced for the computing and drawing courses). Such evolution will enable us to shift part of the content out-of-term, freeing precious time during term for activities which require access to departmental facilities and supervisions, in particular for projects. Consideration would be given to any potential access implications of this shift, i.e. for students who need to work out of term for financial reasons.

3. Attributes of Engineering Tripos graduates: draft for comment

It is proposed that the revised course should aim to produce graduates with the following attributes:

- **analytical** (able to: apply engineering science and mathematics to both create and solve an approximate model for an engineering problem; collect and manage data; rely on facts and data to inform decision making);
- **communicative and collaborative** (able to: express their ideas clearly and concisely in a format and language appropriate to the intended audience; listen and engage in debate; work as part of a project team and support other members; influence decisions and lead work when appropriate);
- **contextually aware and responsible** (able to: show awareness of the external constraints on engineering solutions including commercial, social, political, ethical and environmental factors; demonstrate professional and ethical commitment and respect for good practice and codes of conduct; appreciate the broad remit of engineering in addressing important societal issues);
- **creative** (able to: identify, approach and explore problems with an open mind; formulate design specifications based on an incomplete and/or ambiguous problem description; propose multiple solutions to an engineering design specification; progress by iteration and learn from failure);
- **critical and independent** (able to: evaluate technical information and assess the relative merits of different solutions to an engineering proposal; identify knowledge gaps and undertake further research; contribute to and drive scientific and technological innovation);
- **grounded and practical** (able to: perform order of magnitude estimates and make reasonable assumptions; develop prototypes and test ideas using standard hardware and software tools);
- **inclusive and culturally agile** (sensitive to, and respectful of, personal and cultural differences, able to communicate and operate effectively in a diverse environment);
- **interdisciplinary** (able to: work across engineering disciplines, drawing analogies and transferring knowledge; interact effectively with stakeholders beyond engineering practice, including management, professionals from other sectors and customers).

This list is circulated for comment as the agreed attributes will inform future decisions about the content of the revised course.