Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Emergence of Technologies

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What will you learn from this Elective?	The emergence of technologies is an ideal topic for promoting the student attributes that are the ultimate learning objectives of TEP modules. It will be of particular benefit for students who are taking their primary degree outside the STEM disciplines. The emergence of technology requires the study of how: history, science, economics, sociological effects, materials, sources of power, climate and human ingenuity, all play a part in the development and adoption of new technologies. This programme of study gives students an introduction to a wide range of technologies and will expose students to new concepts and help them to question established "truths" regarding the linkages between basic science, research and the mechanisms involved in the emergence of new technologies. The module will be invaluable for any students who hope to become entrepreneurs because it will familiarise them with many cutting edge technologies and make them aware of the many factors that underpin the successful development and adoption of new technologies. This course of study will: • Familiarise students with a wide range of current technologies; • Enable students to identify the factors that lead to the successful development and adoption of new technologies (a necessary perspective for entrepreneurs or researchers who hope to commercialise their research); • foster reflection, inquisitiveness, skills of analysis and critical thinking; • engage students in learning opportunities outside their home discipline and will give students the opportunity to develop the skills associated with working as part of a team; • provide students with opportunities think independently, communicate effectively, and act responsibly. (The need to act responsibly will be highlighted through the study of sustainability as a key requirement of new technologies). • examine critical issues related to human survival. Solving the problems of *Climate Change* and addressing the impact of the human population on the world's ecosystem will necessitate a multi-disciplinary approach. The world's seven billion plus population is kept alive by modern technologies.
Student Workload	**Contact hours** 22 hours of lectures and 11 hours of timetabled group project sessions. **Self-directed study** 70 hours of self-directed study, including the time spent in the preparation of individual and group assessments and self-reflective writing. **Group Work** 33 hours (11 hours timetabled + 22 hours of group interaction).

Assessment Components	**Assessment preparation** 11 hours in total (actual time spent writing their report and essay, or generating posters and presentations). **Reflective writing** 3 hours. **Total Hours** 33 Timetabled hours + 22 hours of group interaction + 70 hours of self-directed work including the time spent on preparing work for submission. The total number of hours is 122. The assessment of the students will comprise the following four elements: **1. Individual Report (30%)** Each student will be tasked with writing a short report (no more than 2,000 words) and preparing a poster presentation on a specific technology, which will be unique to the student. The student will be required to research the development of the technology and will be required to give a summary of how the technology works, in broad terms. The development of food canning is an example of an ideal technology for this exercise. Canning had its origins in the need to provide food to armies on the march, it developed with partial success before air-borne bacteria were understood and matured as canning technology and the science behind food preservation matured. The poster presentations will be displayed during one of the sessions timetabled for group work and part of their assessment will be based on their assessment of their peers' work: each student will be required to score three other posters under a number of headings using a pre-printed form. The students' posters and reports will be marked by the lecturers, as will their assessments of their peers' projects. **2. Group Challenges (30%)** Each group will take part in three challenges each worth 10% of the overall grade. The groups will comprise four or five students, ideally from a range of home disciplines. The fact that the students will be from different home disciplines has great potential advantages but may make face-to-face meetings outside the timetabled slots difficult. Therefore it must be assumed that while some preparatory work can be done via email etc. the core activities must take place during the timetabled sessions. To ensure the maximum benefit from the timetabled session the group challenges will be run using a methodology similar to that used in a hackathon. The objective is to avoid students having to produce written group reports, which would take up too much of the time. Instead students will complete pre-printed questionnaires during the timetabled project sessions. Students will be given advance notice of the general topic that their challenge will cover two weeks before the challenge. One week before the session the group will receive details of the challenge and the

	students will be tasked with developing a proposal. A week later, during the timetabled session, the group will be given a pre-prepared form to complete. They will be tasked with giving a brief summary of their concept and will then be asked to comment on particular aspects of their concept, the particular questions won't be flagged in advance. As an example, two weeks before the exercise the team might be informed that their challenge will relate to land mines, notionally a defensive technology but well known to cause civilian injuries up to decades after their deployment. One week before the formal session they will be given a brief to develop a new land mine that either biodegrades to a harmless state over time or can be disarmed in a fool-proof manner. This will give the group a week to propose a conceptual technical solution. During the formal session they will spend approximately fifteen minutes describing their concept and then they will answer unseen question designed to assess the level of thought they have applied to the problem. In the landmine case they might be asked to critique a different concept, provide feedback on the key ethical issues, suggest an alternative approach, answer questions around the safe removal of the landmines or their transportation etc. Each group will complete three such challenges. The group session following a challenge will involve a discussion of the challenge, this will also feed into the assessment. This format is designed to encourage students to spend the time allocated to group work on brainstorming and critiquing their proposed solutions, rather than on writing reports. **3. Reflective learning (5%)** On starting the module students will complete a simple on-line MCQ to identify their familiarity with technology on entry to the module. They will also be required to complete a similar MCQ at the end of the course. This will give quantitative feedback on how the students' familiarity with technical concepts and terms has improved. A small amount of credit will be allocated to this exercise to encourage students to complete the questionnaire and to give them the goal of familiarising themselves with general technical terms. **4. Individual essay on the emergence of technology (35%)** The final, and most heavily weighted, assessment will comprise an individual essay on the factors that influence the development of new technologies (maximum of 3,000 words). The students will be given this assignment at the start of the module but they will be free to submit it at any time after the reading week up until the end of the last teaching week. It will also be made clear that their essay must do more than simply reproduce the material presented in the lectures. This assignment will encourage the students to engage in the lectures and to undertake independent reading (research).
Indicative Reading List	A written set of notes that cover the key points addressed in the lectures and copies of any *Powerpoint* slides used will be available to the students. This is to avoid the need for students to take detailed notes during the lectures thus enabling them to engage more fully. The reading list below is indicative of the texts that will be suggested. Note that these titles have all been written with a lay reader in mind and none rely on previous knowledge of technology. They are, in the

	main, books that have been written to entertain and most of them explore the underlying themes behind the development of technology. Two of the books, "The Shock of the Old" and "A Short History of Progress" question the commonly held views of technical progress. These and similar texts will be included to encourage students to think critically. These are texts that don't have to be read from cover to cover but will reward even the browser. 1. The Engineering Book: From the Catapult to the Curiosity Rover, 250 Milestones in the History of Engineering, by Brian Marshall, Sterling, 2015 2. The Shock of the Old: Technology and Global History Since 1900, by David Edgerton, Profile Books, 2008 3. A short history of progress, by Ronald Wright, Canongate Books, 2006 4. A Short History of Technology: From the Earliest Times to A.D. 1900, by T. K. Derry, Dover, 2003 Other material will be placed on the suggested reading list, including authors who bring particular perspectives to the development of technology, for example, Bruno Latour with respect to technology and society. The Transactions of the International Journal for the History of Engineering and Technology, formerly the Transactions of the Newcomen Society, will be identified as a useful resource with a hundred years of papers detailing the development of particular technologies and the overall study of the emergence and dissemination of technology.
Learning Outcomes	On completing this module students will be able to; 1. Describe and explain the technologies that underpin modern life and how they developed. The technologies considered include: the production of food, the production of power, the production of materials, the manufacture of products, transportation, communication, information processing, entertainment, healthcare, and artificial intelligence and machine learning. 2. Identify the many factors at play in the emergence, development and exploitation of successful technologies. 3. Select and appraise new technologies that have the potential to address a recognised need and identify and evaluate potential issues that might hinder the development or deployment of a new technology. 4. Critique the sustainability of and examine the ethical issues arising from the development of a new technology. The need for a learning outcome that includes an international dimension is present in all the four learning outcomes listed above because the development of technology is an international story where events on one continent had profound if often unrecognised effects on the rest of the world. For example, the collapse of native American civilisations that followed the small pox epidemics that arose from encounters with European adventurers in the sixteenth century lead to the gold and silver reserves of the Americas being shipped back to Europe. This mass influx of capital is now recognised by some as having been a key driver in the subsequent industrial revolutions in Europe. Similarly the development of cotton mills in

	the UK must also be seen as being dependent of the slave trade, which provided the massive increase in slave labour required to grow cotton in the United States. These and other international aspects to the development of technology will be addressed. The first learning outcome requires student to “describe” and “explain”. The requirement that students will be able to communicate both in writing and orally is at the centre of the modules learning outcomes. The students will also be required to work in interdisciplinary groups and this will give students an opportunity to experience working in a group comprising people with different expertise.