MODULE DESCRIPTOR 2021/22

CL327 – Engineering for Global Development

<table>
<tr><td colspan="2">Registrar: Dr Jen Roberts</td><td colspan="2">Taught To (Programme): BEng/MEng Civil Engineering/Civil & Environmental Engineering</td></tr>
<tr><td colspan="2">Other Lecturers Involved:

External speakers:
Emma Crichton (Engineers without Borders)
Prof Ana Maria Esteves (Community Insights Group)</td><td>Credit Weighting: 10</td><td>Semester: 1</td></tr>
<tr><td colspan="2">Assumed Pre-requisites: None</td><td>Compulsory</td><td>Academic Level: 3</td></tr>
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Class Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Coursework	Project	Private Study	**Total**
7	20			70	3	100

Class Aim(s)

This class aims to:
- Introduce students to the role of engineers and engineering for global sustainable development.
- Develop student knowledge and understanding of sustainable development principles and the importance of context-appropriate engineering design and implementation.
- Introduce students to the influence that (sometimes competing) environmental, social, economic, political, technological or other factors have on engineering decisions, including the design, implementation, maintenance and evaluation of solutions.

Learning Outcomes

On completion of the class the student is expected to be able to:

LO1 Understand and appreciate the social, economic, and environmental implications of engineering decisions at a local and global level, and thus the importance of globally responsible (sustainable) engineering development.

LO2 Identify and explain how and why context-specific factors (including social, environmental, ethical, economic, and commercial considerations) affect engineering judgement and design.

LO3 Demonstrate how context-specific factors are considered and implemented in engineering design, including how the problem statement and design criteria are defined, how design options are evaluated, how the final design is developed, and how implementation and maintenance pathways are planned.

LO4 Work together effectively to communicate clearly (in oral and written forms, and through visual forms including sketches, drawings and poster presentation) the technical and non-technical aspects of their proposed designs with reference to context-specific influencing factors.

Syllabus

The class will teach the following:
- **Principles of responsible engineering:** The tenets of sustainability and the implications of engineering decisions at a local and global level, and thus the importance of globally responsible – sustainable - engineering development.
- **Design:** Including the process of design (including design stages: inception, conceptual design, detailed design), preparation of problem statement and design criteria that reflect the design context, techniques for ideas mapping, systematic evaluation of design options (scoring matrices, controlled convergence)
- **Selecting or designing appropriate engineering solutions:** Including the relevance of local context to different engineering projects (environmental, socio-cultural, technological, political, economic context) through case studies, and with particular focus on the Social Impact Assessment techniques in the context of responsible development.

- **Application to real context:** The above understanding will be developed and applied in the context of a real community through Engineers without Borders (EWB) Engineering for People Design Challenge. Through a group project, students will develop an appropriate engineering solution for a local community under their chosen design area(s) (Water, Sanitation, Energy, Waste, Transport, Digital, Food, Built Environment). Context specific information and data for the target location and community is provided by EWB. The top five group projects are submitted for external review and consideration for entry into a national competition, the Grand Final.

Assessment Criteria

For each of the Course Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1 Understand and appreciate the social, economic, and environmental implications of engineering decisions at a local and global level, and thus the importance of globally responsible (sustainable) engineering development.
C1 The ability to describe the principles of sustainable development, and the importance of social, environmental and economic impact.
C2 Understanding of how engineering activities can support (or hinder) sustainable development.
C3 The ability to identify the range of contexts in which engineering knowledge can be applied.

LO2 Identify and explain how and why context-specific factors (including social, environmental, ethical, economic, and commercial considerations) affect engineering judgement and design.
C1 The ability to identify a range of context-specific factors and describe the relevance of these factors for different design solutions.
C2 The ability to evaluate decisions (design, policy, planning) with regards to sustainable development goals, and with regards to appropriateness to local context – including heritage.

LO3 Demonstrate how context-specific factors are considered and implemented in engineering design, including how the problem statement and design criteria are defined, how design options are evaluated, how the final design is developed, and how implementation and maintenance pathways are planned.
C1 The ability to investigate a given context and/or design community and to define a problem and design criteria that reflect context-specific constraints (and strengths)
C2 The ability to refer to – and reflect - these constraints in the development and systematic evaluation of design solutions.
C3 The ability to ensure fitness for purpose for all design aspects of the problem including production, installation, operation, maintenance and disposal.

LO4 Work together effectively to communicate clearly (in oral and written forms, and through visual forms including sketches, drawings and poster presentation) the technical and non-technical aspects of their proposed designs with reference to context-specific influencing factors.
C1 The ability to communicate important design aspects within the specific context.
C2 The ability to justify the proposed design, and the strengths and limitations of this design.
C3 The ability to communicate ideas through oral and written forms, and through visual forms including sketches and drawings.

The standards set for each criterion per Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessments.

Principles of Assessment and Feedback (*https://www.strath.ac.uk/staff/policies/academic/*)

Principles of Assessment are incorporated in the following ways:
- The assessments align clearly to the Learning Objectives.
- Detail on the assessment method, timetable and marking criteria are available to all class participants at the start of the course.
- Mid-term assessment and feedback is designed to feed into improving end-of-semester assessments.
- Assessment is provided against clearly defined criteria.

Principles of Feedback are incorporated in the following ways, with the purpose of supporting effective learning and skills development.
Informal feedback:
- *Peer-to-peer:*
  - Within-group feedback: as students work together in their design groups (of 4 to 5 students) they will give and receive feedback amongst group members.
  - Between-group feedback: Tutorials together with other design groups will provide opportunity to give and receive feedback between groups.
- *Staff-to-student*:
  - Weekly 'drop-in' style tutorials support frequent interaction and dialogue between teaching staff (incl. class registrar, guest contributors, and demonstrators) and students (groups / individuals) to support student development of learning of the global dimension of engineering, and engineering for sustainable development in particular, and to feedback on the group design project and progress.
  - A structural compulsory tutorial in week 5 will provide specific feedback on progress to each design group.
- *Student-to-staff:*
  - within classes there will be polls, and also Engineers without Borders administer a two-wave survey at the start and end of the semester.
  - A MyPlace forum will enable groups to ask questions about any aspect of the course between synchronous engagement.
  - Tutorials will include opportunity for dialogue on what is working well and what is working less well about the class.

Formal feedback
- *Peer-to-peer*:

- Within-group feedback: there will be a compulsory peer-assessment element for each group assignment.
  - Between-group feedback: for group presentation assignments, design groups will provide feedback to other design groups.
- *Staff-to-student*:
  - Formal feedback will be provided for all assessments (mid-term and final design review, and the design report).
  - General feedback from Module Evaluation Surveys and all assessments will be presented in class or via audio or written feedback.
  - MyPlace will be used for delivering feedback and to make assessment forms/criteria are accessible to students.
- *Student-to-staff*.
  - Students will provide formal feedback via Module Evaluation Surveys.
  - A class-specificl evaluation form will be provided at end of the semester where students can anonymously give their views on any aspect of the class and suggest improvements.

At all times, feedback will be given with the aim of promoting effective student learning and supporting student development. Feedback will be delivered in a fair and transparent way. The methods of assessment and feedback will be clearly communicated to all students. The feedback practice is continuously reviewed to ensure that this objective is being met.

Recommended Reading

A list of resources relevant to the community selected for the Engineering for People Design Challenge will be provided to students at relevant points through the Semester via MyPlace.

Recommended reading:
Books

- A Whole New Engineer: The Coming Revolution in Engineering Education. Book by Catherine Whitney, David E. Goldberg, and Mark Somerville
- There Is No Planet B: A Handbook for the Make Or Break Years. Mike Berners-Lee
- Aid on the Edge of Chaos: Rethinking International Cooperation in a Complex World. Ben Ramalingam
- Royal Academy of Engineering: Creating Systems that work.

TED talks:

- Sustainable community development: from what's wrong to what's strong | Cormac Russell | TEDxExeter
- Learning from failure | David Damberger | TEDxYYC
- The danger of a single story | Chimamanda Ngozi Adichie

For reading about international development more generally, the following resources are recommended:

- Chambers, Robert (2005) Ideas for development. ISBN1844070883. London; Sterling. *Available at the library*.
- Lambert, Robert & Davis, Jan (2002) Engineering in Emergencies – a practical guide for relief workers. ISBN 9781853395215. *Available at the library*.
- Lucena, Juan, Schneider, Jen and Leydens, Jon A. (2010) Engineering and Sustainable Community Development. Synthesis Lectures on Engineers, Technology and Society, 2010, Vol. 5, No. 1 , Pages 1-230

PLEASE NOTE:
Students need to gain a summative mark of 40% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of coursework.

Resit Arrangements

Coursework (100%)

Approved

Programme Director Signature:	
Date of Last Modifications:	

Assessment and Feedback Schedule

Class Code	CL327	Class Title	Engineering for Global Development	

Brief Description of Assessment

Mid-term review (group presentation) – Week 6 (15%)

Final design review (group presentation) – Week 10 (15%)

Design Report (group report submission) – Week 11 (70%)

Each have a group peer-assessment and individual marks will be weighted accordingly.

Indicate in the tables below the Hand-Out (H), Submission (S) and Feedback (F) dates for each lab report/coursework/project and the timing of each Exam/Class Test (E), (T). Include duration of exam in brackets (e.g. E (2)).

Semester 1

Assessment type (& title)	LOs	Weight (%)	Individual / Group	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
Mid-term review (group oral presentation)	1,2,3	15	Group	H		H			S	F					
Design Review (group poster presentation)	1,2,3	15	Group	H									S	F	
Design Report (group submission)	1,2,3	70	Individual	H										S	F

Semester 2

Assessment type (& title)	LOs	Weight (%)	Individual / Group	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period

Mapping Module Learning Outcomes to AHEP

Module Learning Outcome	**Engineering Council AHEP competencies:** **Knowledge, Understanding and Ability**
LO1 Understand and appreciate the social, economic, and environmental implications of engineering decisions at a local and global level, and thus the importance of globally responsible (sustainable) engineering development. **LO2** Identify and explain how and why context-specific factors (including social, environmental, ethical, economic, and commercial considerations) affect engineering judgement and design.	**Science and Mathematics**: • Understanding of concepts from a range of areas, including some outside engineering, and the ability to evaluate them critically and to apply them effectively in engineering projects. **Economic, legal, social, ethical and environmental context** • Knowledge and understanding of the commercial, economic and social context of engineering processes • Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate • Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues, and an awareness that these may differ internationally
LO3 Demonstrate how context-specific factors are considered and implemented in engineering design, including how the problem statement and design criteria are defined, how design options are evaluated, how the final design is developed, and how implementation and maintenance pathways are planned.	**Science and Mathematics**: • Understanding of concepts from a range of areas, including some outside engineering, and the ability to evaluate them critically and to apply them effectively in engineering projects. **Engineering Design**: • Understanding of engineering principles and the ability to apply them to undertake critical analysis of key engineering processes • Understanding of, and the ability to apply, an integrated or systems approach to solving complex engineering problems **Design:** • Investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards • Work with information that may be incomplete or uncertain, quantify the effect of this on the design and, where appropriate, use theory or experimental research to mitigate deficiencies • Apply advanced problem-solving skills, technical knowledge and understanding to establish rigorous and creative solutions that are fit for purpose for all aspects of the problem including production, operation, maintenance and disposal • Plan and manage the design process, including cost drivers, and evaluate outcomes • Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations **Economic, legal, social, ethical and environmental context**

	Economic, legal, social, ethical and environmental context • Knowledge and understanding of the commercial, economic and social context of engineering processes. • Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate. • Awareness of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues, and an awareness that these may differ internationally. • Knowledge and understanding of risk issues, including health & safety, environmental and commercial risk, risk assessment and risk management techniques and an ability to evaluate commercial risk
LO4 Work together effectively to communicate clearly (in oral and written forms, and through visual forms including sketches, drawings and poster presentation) the technical and non-technical aspects of their proposed designs with reference to context-specific influencing factors.	**Design:** • Communicate their work to technical and non-technical audiences. • Demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the ability to apply and adapt them in unfamiliar situations. **Additional general skills** • Apply their skills in problem solving, communication, working with others, information retrieval and the effective use of general IT facilities • Exercise initiative and personal responsibility, which may be as a team member or leader

JBM Programme Threads

Thread	Primary	Secondary	Contributory
Design	• Students must reflect context-specific constraints when defining the problem statement and design criteria. • Students complete three designs that will improve quality of life in the target community for their chosen design area (Water, Sanitation, Energy, Waste, Transport, Digital, Food, Built Environment) before assessing which is the		

	best of the three, and moving on to the detailed design stage. • The class develops students design skills and the creative process as well as their ability to investigate and define the problem and define the key and secondary design constraints and develop methods for critically evaluating concept designs against design objectives/criteria and refining them • Students must work with information that may be incomplete or uncertain. For this they must demonstrate information retrieval skills and the effective use of general IT facilities. For example to complement the site-specific information and data provided by EWB, students are responsible for gathering the required information themselves from a diverse range of sources such as Google Earth, national data tables, and the online design challenge forum in which students can ask questions to and receive answers from the target community. • Students must be able to demonstrate wide knowledge and comprehensive understanding of design processes and methodologies and the need to adapt them to different context.		
Health, Safety & Risk Assessment		• Aspects of Health, Safety & Risk Assessment are considered in the design selection process, to scope differences in Health, Safety & Risk Assessment in Scotland and the developing country.	
Sustainability	• Students must consider the principles of sustainability and use these to decide their design criteria and design outcomes. • Students must exhibit knowledge and understanding of the commercial, economic and social context of the engineering process in the international development context. • Students are supported to consider the social, environmental and physical aspects at every stage of their design so as to minimise negative enviro-social impacts, maximise positive impacts, and ensure a sustainable and locally-appropriate design. They are encouraged to perform environmental and social impact assessments around their design.	• Through case studies, students are made aware of relevant legal requirements governing engineering activities, including personnel, health & safety, contracts, intellectual property rights, product safety and liability issues. Students should develop an awareness that these may differ internationally.	

	• Students must show understanding of the requirement for engineering activities to promote sustainable development. • The availability and procurement of local materials/resources considered at concept evaluation stage.		
Maths for Engineers	• Maths and engineering concepts learned in other classes are applied to a real-world engineering project in this class. • Students much demonstrate understanding of concepts adapted from a range of areas, including some outside engineering, and the ability to evaluate them critically and to apply them effectively in engineering projects. For example, calculations are required for concept and detailed designs (e.g. water flow rates, pipe pressure losses, quantities of materials).		
Industrial Engagement	• A visiting industry speaker advises the students on social impact assessment of the designs. This is a crucial part of the design process as it directly affects the assessed effectiveness of the design. • Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate.	• From a range of contributors presenting 'real world' international development case studies, students will be encouraged to develop their knowledge and understanding of the commercial, economic and social context of engineering processes.	
Digital Technologies	• Students must work as a group to solve a complex, interdisciplinary and open-ended problem that combines engineering, the environment and society in the context of international development. • Students will use knowledge gained from their other classes, that gained from self-study during this class, and their own judgement. • Team work, delegation, and communication skills are critical, as is exercising self-management. • Students must be able to communicate their work to technical and non-technical audiences.		