Unit 4062: Professional Engineering Practice

Unit Code: M/651/0803

Level: 4

Credits: 15

Introduction

The work of the engineer is key to the development and progress of our society. The decisions they make in the course of their everyday work can be life-changing in positive ways or, if poorly made, can be life-threatening. Accordingly, the engineer must work to strict codes of professionalism in all aspects of their work.

This unit outlines the background to the legislation, professional codes of practice and operational competencies that underpin the development of the professional engineer. It also considers the roles of problem-solving, communication, team working and professional responsibility.

Elements of personal and professional development, reflective thinking, career planning and leadership are considered as well. The increasing necessity for a holistic approach to sustainability in design, manufacture, and reuse and recycling are emphasised.

On successful completion of this unit, the student will be well prepared for further study at levels 5 and 6, working towards membership of an appropriate professional institution at Incorporated Engineer level.

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Learning Outcomes

By the end of this unit the student will be able to:

LO1 Determine the roles, responsibilities and competences of the professional engineer

LO2 Describe the regulatory, legislative and ethical frameworks that govern the work of the professional engineer

LO3 Review the roles of communication, team working and leadership in the development of professional engineers

LO4 Discuss how professional engineers can develop holistic approaches to the sustainability of manufacturing processes.

Essential Content

LO1 Determine the roles, responsibilities and competences of the professional engineer

Role of the professional engineer:

Transforming ideas and materials into products and services: design, build, test and improve; consideration of the whole life cycle of the output of the engineer's work, including sustainability and end-of-life provision of recycling and reuse.

Responsibilities:

The importance of proper risk identification, assessment and mitigation; appropriate safety factors; examples of discipline-specific failures due to poor engineering/lack of proper 'what if' procedures

Understanding that human factors affect engineering processes

Adherence to codes of conduct; acting with due care, skill and diligence by recognising appropriate behaviours and possible limitations; preventing avoidable dangers/adverse impact on the environment; enhancing operational competence

The importance of considering the effects of certain behaviours and values: attitude, persuasion, coercion, rapport, authority

Effects of external influences: stress, time pressure, fatigue, memory, capability, motivation, knowledge, experience, health, alcohol, drugs and criminal behaviour

Personal and corporate privacy and security.

Competences:

Digital skills and industrial digitalisation technologies (IDTs); research skills − find, extract, organise, analyse, evaluate and use or present relevant information; project planning and management (i.e., change management, compliance in delivering outputs, responsible planning and work prioritisation, predictive maintenance); financial literacy (e.g.
financial planning, data, reporting); individual and team approaches to solving problems and risk management through use of methods such as Fishbone, practical problem solving (PPS), root cause analysis (RCA), advanced Product Quality Planning (APQP) and process failure mode effects analysis (PFMEA); project management techniques (e.g. SWOT, stakeholder matrices, risk mapping, radar chart and summary risk profiles), time management, organisation and record-keeping; sketching, drawing, use and interpretation of computer-aided design (CAD)

Professional engineering capabilities: installation, commissioning, shut-down, start-up and maintenance/service/support of a wide range of systems and devices; use of relevant manufacturing and production methods; ability to follow and apply latest trends in engineering and manufacturing (e.g., lean methods and tools used in manufacturing and engineering such as Kaizen, Six Sigma, 8 wastes, 5S's and Poka-Yoke), commitment to upskilling/reskilling, and continued professional development.

Reflective practice: cycle of reflection in action and on action, refining ongoing professional practice (future behaviour), setting goals, reviewing again to achieve sustainable performance; evaluation of own and others' work

Avoidance of generalisation; focus on personal development in a critical and objective way.

LO2 **Describe the regulatory, legislative and ethical frameworks that govern the work of the professional engineer**

Regulatory and legislative frameworks:

Global, European and national regulatory influences on engineering and the role/occupation of the engineer (e.g. the Royal Academy of Engineering and the Engineering Council in the UK); role and responsibilities of the Engineering Council and professional engineering institutions (PEIs), UK Standard for Professional Engineering Competence (UKSPEC), or international equivalents

Relevant health and safety standards, codes and regulations; principles of functional machinery and/or process safety, including SIL (safety integrated level) and PL (performance level) terminology; appropriate sector legislation for quality control/assurance and management (e.g. electrical safety system legislation and directives, emissions, construction and use, environmental legislation, UN Sustainable Development Goals, British Standards Institution (BSI) and International Organization for Standardization (ISO) standards e.g. ISO 14090: 2019 Adaptation to climate change)

Responsibilities at various levels of engineering (e.g. Engineering Council Technical, Incorporated and Chartered Engineer professional registration levels, or international equivalent) including secure operations and application of appropriate processes, policies and legislation in the context of business goals, vision and values; responsible selection of tools/techniques in upgrading and maintaining systems; resilience in undertaking tasks and working securely within the business.

Ethical frameworks:

The Engineering Council and The Royal Academy of Engineering's Statement of Ethical Principles; The National Society for Professional Engineers' Code of Ethics.

LO3 **Review the roles of communication, team working and leadership in the development of professional engineers**

Communication:

Listening, non-verbal communication, clarity and brevity, friendliness, role of humour; confidence, empathy, open-mindedness, respect, feedback and picking the right medium for presentations

Presentation skills, use of presentation software, summaries and presentation notes.

Team working:

Group expectations, dealing with reactions and disagreements, allowing and encouraging participation, acting on agreed outcomes; the negative effects of communication without cause; disillusioned colleagues, persuasion and negotiation

Rewarding and motivating; peer assessment of work, mentoring at regular intervals to ensure correct working practices, getting and receiving feedback

Ensuring inclusivity and equality of opportunity; respecting and encouraging diversity; avoiding stereotyping.

Leadership:

The role of the leader; vision, responsibility and accountability

Decision-making, creative problem-solving, adaptability, delegation, trust and confidentiality

Setting expectations and goals; effective stakeholder engagement and managing job roles and responsibilities; developing accessible, inclusive and diverse products and workplace culture; strategic resource allocation and prioritisation; managing performance and encouraging development.

LO4 **Discuss how professional engineers can develop holistic approaches to the sustainability of manufacturing processes**

Design optimisation:

Overview of manufacturing methods for design of products, Design for Manufacture (DFM), Design for Assembly (DFA) and Design for Disassembly (DFD) as more holistic optimisations of product design to reduce complexity; simplification of assembly and finishing processes by design; quality assurance by design to ensure operation, consistency and quantification of enhancement of manufacturing and process applications

Concepts of the perfect design cycle, product stewardship, dematerialisation, modularity, longevity and design for disassembly

Recyclability, repairability, reusability, re-manufacture; efficiency of active products (e.g. light bulbs, washing machines or vehicles)

Advancements in design for Industry 4.0.

Environmental legislation:

Response to legislative change (e.g. termination of petrol and diesel vehicle production); consideration of diminishing supply of essential raw materials (e.g. oil, aluminium ore and rare earth elements) and development of man-made substitutes, to include cost, supply and political considerations.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Determine the roles, responsibilities and competences of the professional engineer		
P1 Describe the importance of the identification of risk in the role of the professional engineer. **P2** Determine how responsibilities and human behaviour can impinge on the work of professional engineers.	**M1** Assess the risk factors that require mitigation from a given engineering project specification.	**D1** Differentiate between reflection and evaluation with risk factor examples, using a given engineering project specification, and your own experience.
LO2 Describe the regulatory, legislative and ethical frameworks that govern the work of the professional engineer		
P3 Outline the roles and responsibilities of the professional engineer (IEng) within the Engineering Councils framework (or international equivalent). **P4** Describe the principal UK codes and regulations, (or international equivalents) that control the work of the professional engineer.	**M2** Analyse how engineers use regulatory and legislative frameworks and how the UN Sustainable Development Goals should be considered within a given design specification.	**D2** Evaluate the effect of regulatory, legislative and ethical frameworks on the day-to-day work of the professional engineer, using specific examples.

Pass	Merit	Distinction
LO3 Review the roles of communication, team working and leadership in the development of professional engineers		
P5 Review the most important considerations for good team working and effective leadership in engineering. **P6** Outline the steps for managing effective group communications in engineering.	**M3** Analyse leadership styles and effective communication skills using specific examples from an engineering organisational context.	**D3** Evaluate the most effective approaches to the coaching and mentoring of disillusioned colleagues or of a poorly performing team.
LO4 Discuss how professional engineers can develop holistic approaches to the sustainability of manufacturing processes.		
P7 Discuss the rationale behind the development of Design for Manufacture (DFM) and Design for Assembly (DFA) methodologies. **P8** Describe the concept of the Perfect Design Cycle and show how it incorporates Product Stewardship.	**M4** Assess the effects that fully committing to sustainable design and manufacture would have for a given design specification.	**D4** Analyse how the drive for sustainability can be sustained given the limitations on naturally occurring materials such as oil, aluminium ore and rare earth elements.

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

Bainbridge A.F. (2021) *Ethics for Engineers: A Brief Introduction*. 1st Ed. Oxfordshire: Taylor & Francis Ltd.

Challender J. (2022) *Professional Ethics in Construction and Engineering*. Wiley.

Covello V.T. (2021) *Communicating in Risk, Crisis, and High Stress Situations: Evidence-Based Strategies and Practice*. Wiley.

Dearden, H. (2013) *Professional Engineering Practice: Reflections on the Role of the Professional Engineer*. CreateSpace Independent Publishing Platform.

El-Reedy M.A. (2021) Offshore Projects and Engineering Management. 1st Ed. Elsevier.

Karten N. (2010) *Presentation Skills for Technical Professionals*. IT Governance Ltd.

Kerzner H. (2022) *Project Management: A Systems Approach to Planning, Scheduling, and Controlling.* 13th Edition, Wiley.

Kong K. (2019) *Professional Discourse.* Cambridge University Press.

Lock D. (2013) *Project Management*. 10th Ed. Routledge.

McRae M and Berliner J (2020) *Engineering Made Simple: A Complete Guide in Ten Easy Lessons.* 1st Ed. San Diego: Portable Press.

Muzio D., Sundeep A. and Kirkpatrick I. (2020) *Professional Occupations and Organizations.* Cambridge University Press.

Rausand M. and Stein Haugen S. (2020) *Risk Assessment: Theory, Methods, and Applications.* John Wiley & Sons, Inc.

Temple T.J. and Ladyman M.K. (2022) *Challenges in Risk Analysis for Science and Engineering*. IOP Publishing Ltd.

Wilbers S. (2022) *Persuasive Communication for Science and Technology Leaders: Writing and Speaking with Confidence*. Wiley.

Wright I. (2012) *Risk Evaluation (Engineering Design Book 1)*. Kindle Edition.

Journals

Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.

Control Engineering Practice

Engineering

Engineering Management

Engineering Management Journal

European Journal of Engineering Education

Frontiers of Engineering Management

IEEE Transactions on Engineering Management

Journal of Engineering and Technology Management

Journal of Management & Organization

Journal of Professional Issues in Engineering Education and Practice

Results in Engineering

Links

This unit links to the following related units:

Unit 4004: Managing a Professional Engineering Project

Unit 4031: Introduction to Professional Engineering Management

Unit 5002: Professional Engineering Management

Unit 5041: Engineering Project.