

Unit 1: Engineering Design

Unit code K/615/1475

Unit type Core

Unit level 4

Credit value 15

Introduction

The tremendous possibilities of the techniques and processes developed by engineers can only be realised by great design. Design turns an idea into a useful artefact, the problem into a solution, or something ugly and inefficient into an elegant, desirable and cost effective everyday object. Without a sound understanding of the design process the engineer works in isolation without the links between theory and the needs of the end user.

The aim of this unit is to introduce students to the methodical steps that engineers use in creating functional products and processes; from a design brief to the work, and the stages involved in identifying and justifying a solution to a given engineering need.

Among the topics included in this unit are: Gantt charts and critical path analysis, stakeholder requirements, market analysis, design process management, modelling and prototyping, manufacturability, reliability life cycle, safety and risk, management, calculations, drawings and concepts and ergonomics.

On successful completion of this unit students will be able to prepare an engineering design specification that satisfies stakeholders' requirements, implement best practice when analysing and evaluating possible design solutions, prepare a written technical design report, and present their finalised design to a customer or audience.

Learning Outcomes

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

1. Prepare an engineering design specification in response to a stakeholder's design brief and requirements.
2. Formulate possible technical solutions by using prepared examples of engineering design specifications.
3. Prepare an engineering industry standard technical design report by using appropriate design calculations, drawings and concepts.
4. Present, to an audience, a recommended technical design solution by using real examples of stakeholder briefs.

Essential Content

L01 **Prepare an engineering design specification in response to a stakeholder's design brief and requirements**

Planning techniques used to prepare a design specification:

Definition of client's/users objectives, needs and constraints.

Definition of design constraints, function, specification, milestones.

Planning the design task: Flow charts, Gantt charts, network and critical path analysis necessary in the design process.

Design process:

Process development, steps to consider from start to finish.

The cycle from design to manufacture.

Three- and five-stage design process.

Vocabulary used in engineering design.

Stage of the design process which includes:

Analysing the situation, problem statement, define tasks and outputs, create the design concept, research the problem and write a specification. Suggest possible solutions, select a preferred solution, prepare working drawings, construct a prototype, test and evaluate the design against objectives, design communication (write a report).

Customer/stakeholder requirements:

Converting customer request to a list of objectives and constraints.

Interpretation of design requirements.

Market analysis of existing products and competitors.

Aspects of innovation and performance management in decision-making.

L02 **Formulate possible technical solutions by using prepared examples of engineering design specifications**

Conceptual design and evaluating possible solutions:

Modelling, prototyping and simulation using industry standard software, (e.g. AutoCAD, Catia, SolidWorks, Creo) on high specification computers.

Use of evaluation and analytical tools, e.g. cause and effect diagrams, CAD, knowledge-based engineering.

L03 Prepare an engineering industry standard technical design report by using appropriate design calculations, drawings and concepts

Managing the design process:

Recognising limitations including cost, physical processes, availability of material/components and skills, timing and scheduling.

Working to specifications and standards, including:

The role of compliance checking, feasibility assessment and commercial viability of product design through testing and validation.

Design for testing, including:

Material selection to suit selected processes and technologies.

Consideration of manufacturability, reliability, life cycle and environmental issues.

The importance of safety, risk management and ergonomics.

Conceptual design and effective tools:

Technologies and manufacturing processes used in order to transfer engineering designs into finished products.

L04 Present, to an audience, a recommended technical design solution by using real examples of stakeholder briefs

Communication and post-presentation review:

Selection of presentation tools.

Analysis of presentation feedback.

Strategies for improvement based on feedback.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
<p>L01 Prepare an engineering design specification in response to a stakeholder's design brief and requirements</p>		<p>D1 Recommend justified improvements to a completed industry standard engineering design specification sample.</p>
<p>P1 Produce a design specification and detail the stages of its production.</p> <p>P2 Explain the influence of the stakeholder's design brief and requirements in the preparation of the design specification.</p> <p>P3 Describe the use of Gantt charts in the preparation of the design specification.</p>	<p>M1 Illustrate the planning techniques used to prepare the design specification.</p> <p>M2 Justify the use of critical path analysis necessary in the preparation of the design process.</p>	
<p>L02 Formulate possible technical solutions to an identified problem by using prepared examples of engineering design specifications</p>		
<p>P4 Explore industry standard evaluation and analytical tools.</p> <p>P5 Discuss the role of conceptual design in formulating a technical solution.</p>	<p>M3 Illustrate the role of modelling and prototyping in suggesting a technical solution to an identified problem.</p> <p>M4 Identify appropriate software and hardware recommended for problem-solving.</p>	<p>D2 Recommend justified improvements to suggested technical solutions to an identified problem.</p>
<p>L03 Prepare an engineering industry standard technical design report by using appropriate design calculations, drawings and concepts</p>		
<p>P6 Prepare an engineering industry standard technical design report and describe the essential elements that need to be included.</p> <p>P7 Assess the limitations of a presented technical design.</p>	<p>M5 Explain the role of design specifications and standards in producing a finished product.</p> <p>M6 Identify compliance, safety and risk management issues present in any engineering design process.</p>	<p>D3 Analyse the effectiveness of a presented engineering industry standard technical design report to produce a fully compliant finished product.</p>

Pass	Merit	Distinction
<p>LO4 Present, to an audience, a recommended design solution by using real examples of stakeholder briefs</p>		<p>D4 Discuss the strategy to be used to make improvements based on feedback obtained from the presentation.</p>
<p>P8 Present the recommended design solution to the identified audience.</p> <p>P9 Explain the communication strategy and presentation method used to inform the stakeholders of the recommended solution.</p>	<p>M7 Analyse the feedback to the presentation of the solution.</p>	

Recommended Resources

Textbooks

DUL, J. and WEERDMEESTER, B. (2008) *Ergonomics for beginners*. 3rd Ed. Boca Raton: CRC Press.

DYM, C.L., LITTLE, P. and ORWIN, E. (2014) *Engineering Design: a Project Based Introduction*. 4th Ed. Wiley.

GRIFFITHS, B. (2003) *Engineering Drawing for Manufacture*. Kogan Page Science.

REDDY, K.V. (2008) *Textbook of Engineering Drawing*. 2nd Ed. Hyderabad: BS Publications.

Links

This unit links to the following related units:

Unit 23: Computer Aided Design and Manufacture (CAD/CAM)

Unit 34: Research Project