UNIVERSITY OF LINCOLN

Programme Specification

Title:

Mechanical Engineering

Final Award: **Bachelor of Engineering with Honours (BEng (Hons))**

With Exit Awards at:
Certificate of Higher Education (CertHE)
Diploma of Higher Education (DipHE)
Bachelor of Engineering with Honours (BEng (Hons))

To be delivered from: 15 Sep 2014

Level	Date
Level 1 or Certificate of Higher Education (CertHE)	2019-20
Level 2 or Diploma of Higher Education (DipHE)	2020-21
Level 3 or Bachelor of Engineering with Honours (BEng (Hons))	2021-22

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1. Introduction

This document describes one of the University of Lincoln's programmes using the protocols required by the UK National Qualifications Framework as defined in the publication *QAA guidelines for preparing programme specifications*.

This programme operates under the policy and regulatory frameworks of the University of Lincoln.

2. Basic Programme Data

Final Award:	Bachelor of Engineering with Honours (BEng (Hons))
Programme Title:	Mechanical Engineering
Exit Awards and Titles	Certificate of Higher Education (CertHE) Diploma of Higher Education (DipHE) Bachelor of Engineering with Honours (BEng (Hons))
Subject(s)	Engineering
Mode(s) of delivery	Full Time Part Time
Is there a Placement or Exchange?	No
UCAS code	H301
Awarding Body	University of Lincoln
Campus(es)	Lincoln Campus
School(s)	School of Engineering
Programme Leader	Rebecca Margetts (RMargetts)
Relevant Subject Benchmark Statements	
Professional, Statutory or Regulatory Body Accreditation	Institution of Mechanical Engineers (IMechE)
Programme Start Date	2019-20

3. Programme Description

3.1 Overview

The Institution of Mechanical Engineers (IMechE) define mechanical engineering as being concerned with “the innovative application of engineering and management sciences that underpin existing and emerging technologies to the complete life cycle of all mechanical devices, machines and systems”. A Mechanical Engineer is therefore a creative person who is able to integrate knowledge based on mathematics, science, design, materials, manufacturing, business and management in order to solve problems that provide infrastructure, goods and services to our society.

With this in mind the curriculum has been developed to provide a general mechanical engineering education, and produce graduates with the strong academic background who are ready to enter cutting edge industry as “industry ready graduates”. Siemens Industrial Turbomachinery Limited share this vision and we have a unique collaboration with them that University: making a multi-million pound commitment to support the School; transferring R&D equipment into the School; and co-locating their training team into the School. The relationship has been strengthened further with the University selected as one of only five Siemens ‘principal partner’ universities in the UK. From this students on our engineering programmes will benefit from industry insider knowledge and skills shared by Siemens engineers working in the sector today.

Focusing strongly on research-informed teaching, we have brought together an international team of staff from a range of disciplines and industry backgrounds to ensure that our students get the most from their course and the best start in their engineering careers. Our innovative and exciting degree courses were regarded so highly by the IMechE that they took the unprecedented step of accrediting our programmes September 2011.?

The content and level of the programme has also been designed such that the BEng (Hons) graduate will partially meet the academic requirements for registration as a Chartered Engineer (CEng). The programme will also begin to develop the professional skills required for CEng registration.

3.2 Aims and Objectives

The overall aim of this programme is to create numerate and highly motivated graduates who will be in demand by a wide spectrum of organizations. The first two years of study lay the common foundations of mechanical engineering principles. The final year provides an opportunity for students to deepen their education in through a broad range of specialist modules that are integrated within the structured learning environment. The overall aims of this programme are:

• To offer an industrially relevant degree programme that places the student’s learning experience at the centre of every activity and provides students with the partial academic requirements for registration as CEng.

• To provide a broad knowledge and understanding of mechanical engineering that is informed by the research activities of the academic staff.

• To produce graduates who can apply fundamental scientific principles and mathematical techniques in order to conceive, realise, create and innovate solutions to engineering problems.

• To equip students with an awareness of engineering in the wider social, ethical, sustainable and economic context.

• To give students the opportunity to develop their intellectual curiosity, their powers of creativity and innovation, and to reach their full potential in all aspects of University life.

• To provide opportunities for access and personal and professional development that will inspire a commitment to life-long learning.

• To produce graduates who are prepared for a career in mechanical engineering.

3.3 Variations to Standard Regulations and Guidance

None

4. Programme Outcomes

Programme-level learning outcomes are identified below.

Refer to *Appendix I – Curriculum Map* for details of how outcomes are deployed across the programme.

4.1 Knowledge and Understanding

On successful completion of this programme a student will have knowledge and understanding of:

1 The fundamental concepts, theories, principles, and limitations of mechanical engineering science, with knowledge of current practice selected areas of engineering (machines and energy, power and energy, or control systems) at an advanced level.

2 The mathematical concepts and principles that is relevant to the analysis and solution of mechanical engineering problems.

3 The principles, processes and methods of design, and how to apply them in the creation of new products and processes.

4 The commercial and economic context of engineering, including the management techniques that are used to achieve engineering objectives.

5 The social and environmental context of engineering and the need for ethical and sustainable practice.

6 The legal frameworks within which engineering activities operate, including industry standards and codes of practice.

4.2 Subject Specific Intellectual Skills

On successful completion of this programme a student will be able to:

7 Integrate their knowledge and understanding of engineering, mathematics, design and business practice to propose solutions to engineering problems.

8 Acquire, evaluate and understand the context of engineering information from a range of sources and apply it in the solution of engineering problems.

9 Use the appropriate analytical or modelling methods, and software tools, to quantify and analyse the performance of engineering components and systems.

10 Use a systematic approach to define and investigate engineering problems and display creativity in establishing engineering solutions.

11 Accommodate technical uncertainty in design development.

12 Develop create and innovative design solutions in non-routine applications.

4.3 Subject Specific Practical Skills

On successful completion of this programme a student will be able to:

13 Produce creative designs that meet technical and user specifications in all aspects of the

product's life cycle.

14 Identify and use laboratory and workshop equipment.

15 Plan and conduct a technical investigation using a wide range of technical and other literature.

16 Use commercial computer software for analysis and design.

17 Write computer programmes to analyse data and solve routine engineering problems.

18 Produce full documentation of the design process and demonstrate compliance with technical, commercial, quality and cost constraints.

19 Work safely within appropriate codes of practice, industry standards, and contractual and quality constraints.

4.4 Transferable Skills and Attributes

On successful completion of this programme a student will be able to:

20 Use ICT effectively to find and manage information.

21 Communicate information orally, visually and in writing to a professional standard.

22 Work in collaboration with others.

23 Be highly motivated and able to work and learn independently.

24 Plan and manage time and resources safely and effectively.

25 Exercise independent thought, and have the confidence to make value judgements based on limited information.

26 Be ready and prepared for their careers and committed to maintaining a high professional and ethical standard in their profession.

For details of each module contributing to the programme, please consult the module specification document.

5. Learning, Teaching and Assessment Strategies

5.1. Learning and Teaching Strategy

The development of the learning outcomes is promoted through the following teaching and learning methods:

• Lectures are the primary means of conveying academic material and information. Most lecture courses provide problem sheets, worked examples and/or case studies. Students will also be directed to suitable resources involving a range of ICT to enable then to develop their understanding of the subject matter during their private-study.

• Tutorials and Example Classes are normally delivered to smaller (than class sized) groups of students. These classes provide an opportunity for academics staff to resolve problems in the students understanding.

• Workshops are used to enable students to work on “open-ended” and often ill-defined problems related to real engineering situations. They also provide good opportunities for developing team-working and communication skills as well as individual skills.

• Laboratory Classes are used to introduce experimental techniques and practical methods. They provide an excellent opportunity for students to practice team-working and communication skills.

• Coursework Assignments are used in a number of modules where students are required to seek additional information so that they can develop and demonstrate their understanding of the course material. Students may be required to work independently or in small groups.

• Oral and Poster Presentations are often included as part of coursework assignments. These presentations allow students to develop their communication skills.

• Formative Assessments do not contribute to the final marks achieved for each module, but provide an opportunity for students to develop their critical evaluation skills and to monitor their own academic progress. They also provide a useful opportunity for lecturers to give feedback to the students and to monitor and improve the students learning experience. These assessments will take the form of diagnostic tests, in-class tests and on-line tests during lectures, and evaluation and discussions relating to logbooks and equipment during laboratory classes. Students will have opportunities to develop their oral and presentation skills during tutorials and workshops.

• The Individual Project is completed in the third year of the degree programme. This project represents a substantial, individual research project on an aspect of mechanical engineering. It is conducted under thesupervision of a member of staff. This project provides excellent opportunity for the student to pull together every aspect of their development during the programme.

Wherever possible, the department will make the maximum use of industry-university links so that graduates will be aware of modern commercial and managerial practices appropriate to the engineering industry. In addition to traditional modes of delivery, workplace experience and industrial exposure is embedded within the program through industry support. This includes industrial speakers, factory tours, summer work placements and engagement in real engineering projects set by industrial collaborators, in-line with Student as Producer principles. The level 2 design engineering module, for example, is based around a specific real-life engineering problem set by industry. Students are required to complete this group project in accordance with a 'gate' system, mirroring the way in which they will be expected to work in industry. This approach is then extended in the level 3 individual project module. The department is constantly reviewing its delivery mechanisms in order to identify further opportunities to embed these Student as Producer principles in order to enhance student learning.

Personal Development Planning:

PDP is the process by which students are able to review, build and reflect on their personal and

educational development in order to get more out from their degree course. Students will primarily engage with the PDP process through the personal tutoring scheme where a member of academic staff will act as a mentor to help individuals to identify areas for development, personal goals, and direct students to resources and support that is available within the School of Engineering (including online training and tutorials), and within the University of Lincoln.

In addition to this scheme, the following modules have been identified as directly contributing towards students PDP.
• Professional & Workshop Skills
• Design Engineering
• Industrial Engineering
• Individual Project (Bachelors)

5.2. Assessment Strategy

Assessment Strategy:
Opportunities for the student to demonstrate achievement of the learning outcomes are provided through the following summative assessment methods:
• Written Examinations are typically of 3 hours duration. The content of these exams is previously unseen by the student, and many modules use written exams as the main assessment method. Different modules will use open or closed book, multiple choice, open ended and essay type exams
• Coursework Assignments, Laboratory Reports, Technical Reports, Technical Notes, Dissertations, Portfolios, Oral and Poster Presentations are widely used through out the degree programme. They may constitute the only or the major form of assessment in some modules (particularly design work), but most modules include both coursework and exams as part of the assessment methods. Coursework assignments increase in size and complexity as student's progress through their degree, and they are designed to give students the opportunity to demonstrate their understanding of the course material (particularly when the student is required to seek additional information). Students are also able to demonstrate their presentation and communication skills. Assignments can be conducted on an individual basis at the beginning of the degree programme, or increasingly as small groups as the student progresses.
• Computer Based Tests and Assessed Simulations are used in modules that involve a substantial computer-based element. These assessments give the students an opportunity to demonstrate their proficiency in a simulated professional situation.
• Peer Assessment is often used in modules that involve a substantial team-working element. Normally, students will moderate the final marks for the group project to reflect the contributions of different team member to encourage full an equal participation by each student. Students may also peer review other student's coursework to develop their critical thinking skills, but this case, the quality of the peer review is assessed.
• Demonstrations of Prototypes and Exhibitions are used to assess practical workshop skills and allow students the opportunity to demonstrate the realisation of a design project.
• Class Tests are conducted during the course of the academic year to assess student's progress. The results from class tests provide a useful opportunity to give developmental feedback to students.
• The Individual Project is the largest individual project and is undertaken during the third year of the degree programme. The project is assessed on via a written dissertation, a conference style oral presentation and the student's response to questions. It is expected to be at a professional level.

6. Programme Structure

The total number of credit points required for the achievement of Certificate of Higher Education (CertHE) is 120.
The total number of credit points required for the achievement of Diploma of Higher Education (DipHE) is 240.
The total number of credit points required for the achievement of Bachelor of Engineering with Honours (BEng (Hons)) is 360.

Level 1

Title	Credit Rating	Core / Optional
Materials and Methods of Manufacture 2019-20	15	Core
Electrical and Electronic Technology 2019-20	15	Core
Professional and Workshop Skills 2019-20	15	Core
CAD and Technical Drawing 2019-20	15	Core
Mathematics for Engineers 2019-20	15	Core
Computing for Engineers 2019-20	15	Core
Thermofluids 2019-20	15	Core
Statics and Dynamics 2019-20	15	Core

Level 2

Title	Credit Rating	Core / Optional
Design Engineering 2020-21	15	Core
Industrial Engineering 2020-21	15	Core
Advanced Thermofluids 2020-21	15	Core
Further Mathematics for Engineers 2020-21	15	Core
Electrical Power and Machines 2020-21	15	Core
Control Systems 2020-21	15	Core
Solid Body Mechanics 2020-21	15	Core
Dynamics and Vibrations 2020-21	15	Core

Level 3

Title	Credit Rating	Core / Optional
New and Sustainable Product Design 2021-22	15	Core
Individual Project (Bachelors) 2021-22	30	Core
Computational Fluid Dynamics 2021-22	15	Optional
Finite Element Analysis 2021-22	15	Optional
Materials Science and Engineering 2021-22	15	Core
Advanced Manufacturing Processes and Systems 2021-22	15	Core
Energy Systems and Conversion 2021-22	15	Core
Combustion, Fuels and Energy 2021-22	15	Core
State-Space Control 2021-22	15	Optional
Signal Processing and System Identification 2021-22	15	Optional

Appendix I - Curriculum Map

This table indicates which modules assume responsibility for delivering and ordering particular programme learning outcomes.

Key: ✓ Delivered and Assessed Delivered ✓ Assessed

Level 1

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CAD and Technical Drawing 2019-20			✓									
Computing for Engineers 2019-20	✓								✓			
Electrical and Electronic Technology 2019-20	✓						✓		✓			
Materials and Methods of Manufacture 2019-20	✓		✓				✓	✓				
Mathematics for Engineers 2019-20	✓	✓					✓			✓		
Professional and Workshop Skills 2019-20				✓	✓							
Statics and Dynamics 2019-20	✓	✓								✓		
Thermofluids 2019-20	✓	✓								✓		

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
CAD and Technical Drawing 2019-20	✓			✓				✓				
Computing for Engineers 2019-20				✓	✓			✓				
Electrical and Electronic Technology 2019-20		✓		✓				✓	✓	✓		
Materials and Methods of Manufacture 2019-20		✓						✓	✓	✓		
Mathematics for Engineers 2019-20											✓	
Professional and Workshop Skills 2019-20		✓	✓					✓	✓	✓		
Statics and Dynamics 2019-20		✓									✓	
Thermofluids 2019-20		✓									✓	

	PO25	PO26
CAD and Technical Drawing 2019-20		

Computing for Engineers 2019-20		
Electrical and Electronic Technology 2019-20		
Materials and Methods of Manufacture 2019-20		
Mathematics for Engineers 2019-20		
Professional and Workshop Skills 2019-20		
Statics and Dynamics 2019-20		
Thermofluids 2019-20		

Level 2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Advanced Thermofluids 2020-21	✓	✓					✓	✓				
Control Systems 2020-21	✓	✓					✓	✓	✓	✓		
Design Engineering 2020-21			✓	✓	✓	✓			✓			
Dynamics and Vibrations 2020-21	✓	✓					✓	✓	✓			
Electrical Power and Machines 2020-21	✓	✓					✓	✓	✓			
Further Mathematics for Engineers 2020-21	✓	✓					✓	✓	✓			
Industrial Engineering 2020-21				✓	✓	✓						
Solid Body Mechanics 2020-21	✓	✓					✓	✓	✓			

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
Advanced Thermofluids 2020-21		✓							✓		✓	
Control Systems 2020-21		✓					✓					✓
Design Engineering 2020-21	✓							✓	✓	✓		
Dynamics and Vibrations 2020-21			✓	✓					✓		✓	
Electrical Power and Machines 2020-21		✓					✓					✓
Further Mathematics for Engineers 2020-21									✓		✓	
Industrial Engineering 2020-21								✓	✓			
Solid Body Mechanics 2020-21			✓	✓					✓		✓	

	PO25	PO26

Advanced Thermofluids 2020-21	✓	
Control Systems 2020-21	✓	
Design Engineering 2020-21		
Dynamics and Vibrations 2020-21	✓	
Electrical Power and Machines 2020-21	✓	
Further Mathematics for Engineers 2020-21	✓	
Industrial Engineering 2020-21		
Solid Body Mechanics 2020-21	✓	

Level 3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Advanced Manufacturing Processes and Systems 2021-22	✓	✓					✓		✓	✓	✓	
Combustion, Fuels and Energy 2021-22	✓	✓					✓	✓	✓	✓		
Computational Fluid Dynamics 2021-22	✓	✓					✓	✓	✓	✓		
Energy Systems and Conversion 2021-22	✓	✓					✓	✓	✓	✓		
Finite Element Analysis 2021-22	✓	✓					✓	✓	✓	✓		
Individual Project (Bachelors) 2021-22	✓		✓		✓		✓	✓	✓	✓	✓	✓
Materials Science and Engineering 2021-22	✓	✓					✓		✓	✓	✓	
New and Sustainable Product Design 2021-22				✓	✓	✓					✓	✓
Signal Processing and System Identification 2021-22	✓	✓					✓	✓	✓	✓		
State-Space Control 2021-22	✓	✓					✓	✓	✓	✓		

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
Advanced Manufacturing Processes and Systems 2021-22		✓	✓	✓	✓							
Combustion, Fuels and Energy 2021-22			✓	✓					✓			
Computational Fluid Dynamics 2021-22			✓	✓			✓		✓			

Energy Systems and Conversion 2021-22			✓	✓					✓			
Finite Element Analysis 2021-22			✓	✓			✓		✓			
Individual Project (Bachelors) 2021-22	✓		✓		✓	✓	✓	✓	✓		✓	✓
Materials Science and Engineering 2021-22		✓	✓	✓	✓							
New and Sustainable Product Design 2021-22	✓					✓	✓		✓	✓		
Signal Processing and System Identification 2021-22			✓	✓					✓			
State-Space Control 2021-22			✓	✓					✓			

	PO25	PO26
Advanced Manufacturing Processes and Systems 2021-22	✓	
Combustion, Fuels and Energy 2021-22	✓	
Computational Fluid Dynamics 2021-22	✓	
Energy Systems and Conversion 2021-22	✓	
Finite Element Analysis 2021-22	✓	
Individual Project (Bachelors) 2021-22	✓	
Materials Science and Engineering 2021-22	✓	
New and Sustainable Product Design 2021-22		✓
Signal Processing and System Identification 2021-22	✓	
State-Space Control 2021-22	✓	

Appendix II - Assessment Map

This table indicates the spread of assessment activity across the programme. Percentages indicate assessment weighting.

Level 1

	01	02	03	04	05	06	07	08	09	10	11	12
CAD and Technical Drawing 2019-20												
Computing for Engineers 2019-20												
Electrical and Electronic Technology 2019-20												
Materials and Methods of Manufacture 2019-20												
Mathematics for Engineers 2019-20					25							
Professional and Workshop Skills 2019-20												
Statics and Dynamics 2019-20												
Thermofluids 2019-20												

	13	14	15	16	17	18	19	20	21	22	23	24
CAD and Technical Drawing 2019-20	100											
Computing for Engineers 2019-20							100					
Electrical and Electronic Technology 2019-20							100					
Materials and Methods of Manufacture 2019-20									25			
Mathematics for Engineers 2019-20												
Professional and Workshop Skills 2019-20												
Statics and Dynamics 2019-20												
Thermofluids 2019-20												

	25	26	27	28	29	30	31	32	33	34	35	36
CAD and Technical Drawing 2019-20												
Computing for Engineers 2019-20												
Electrical and Electronic Technology 2019-20												

Materials and Methods of Manufacture 2019-20				75								
Mathematics for Engineers 2019-20												
Professional and Workshop Skills 2019-20	100											
Statics and Dynamics 2019-20			25									
Thermofluids 2019-20	25											

	37	38	39	40	41	42	43	44	45	46	47	48
CAD and Technical Drawing 2019-20												
Computing for Engineers 2019-20												
Electrical and Electronic Technology 2019-20												
Materials and Methods of Manufacture 2019-20												
Mathematics for Engineers 2019-20												
Professional and Workshop Skills 2019-20												
Statics and Dynamics 2019-20												
Thermofluids 2019-20												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
CAD and Technical Drawing 2019-20						
Computing for Engineers 2019-20						
Electrical and Electronic Technology 2019-20						
Materials and Methods of Manufacture 2019-20						
Mathematics for Engineers 2019-20						75
Professional and Workshop Skills 2019-20						
Statics and Dynamics 2019-20						75
Thermofluids 2019-20						75

Level 2

	01	02	03	04	05	06	07	08	09	10	11	12
Advanced Thermofluids 2020-21												
Control Systems 2020-21												
Design Engineering 2020-21												
Dynamics and Vibrations 2020-21												
Electrical Power and Machines 2020-21												
Further Mathematics for Engineers 2020-21			25									
Industrial Engineering 2020-21									25			
Solid Body Mechanics 2020-21												

	13	14	15	16	17	18	19	20	21	22	23	24
Advanced Thermofluids 2020-21											25	
Control Systems 2020-21					50							
Design Engineering 2020-21												
Dynamics and Vibrations 2020-21							25					
Electrical Power and Machines 2020-21												
Further Mathematics for Engineers 2020-21												
Industrial Engineering 2020-21												
Solid Body Mechanics 2020-21												

	25	26	27	28	29	30	31	32	33	34	35	36
Advanced Thermofluids 2020-21												
Control Systems 2020-21												
Design Engineering 2020-21	100											
Dynamics and Vibrations 2020-21												
Electrical Power and Machines 2020-21	25											
Further Mathematics for Engineers 2020-21												
Industrial Engineering 2020-21												
Solid Body Mechanics 2020-21			25									

	37	38	39	40	41	42	43	44	45	46	47	48
Advanced Thermofluids 2020-21												
Control Systems 2020-21												
Design Engineering 2020-21												
Dynamics and Vibrations 2020-21												
Electrical Power and Machines 2020-21												
Further Mathematics for Engineers 2020-21												
Industrial Engineering 2020-21												
Solid Body Mechanics 2020-21												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Advanced Thermofluids 2020-21						75
Control Systems 2020-21						50
Design Engineering 2020-21						
Dynamics and Vibrations 2020-21						75
Electrical Power and Machines 2020-21						75
Further Mathematics for Engineers 2020-21						75
Industrial Engineering 2020-21						75
Solid Body Mechanics 2020-21						75

Level 3

	01	02	03	04	05	06	07	08	09	10	11	12
Advanced Manufacturing Processes and Systems 2021-22												
Combustion, Fuels and Energy 2021-22												
Computational Fluid Dynamics 2021-22												

Energy Systems and Conversion 2021-22												
Finite Element Analysis 2021-22												
Individual Project (Bachelors) 2021-22												
Materials Science and Engineering 2021-22												
New and Sustainable Product Design 2021-22												
Signal Processing and System Identification 2021-22												
State-Space Control 2021-22												

	13	14	15	16	17	18	19	20	21	22	23	24
Advanced Manufacturing Processes and Systems 2021-22								25				
Combustion, Fuels and Energy 2021-22						35						
Computational Fluid Dynamics 2021-22									50			
Energy Systems and Conversion 2021-22												
Finite Element Analysis 2021-22		100										
Individual Project (Bachelors) 2021-22												
Materials Science and Engineering 2021-22					25							
New and Sustainable Product Design 2021-22									50			
Signal Processing and System Identification 2021-22						25						
State-Space Control 2021-22												

	25	26	27	28	29	30	31	32	33	34	35	36
Advanced Manufacturing Processes and Systems 2021-22												
Combustion, Fuels and Energy 2021-22		25										
Computational Fluid Dynamics 2021-22				50								
Energy Systems and Conversion 2021-22		25										
Finite Element Analysis 2021-22												
Individual Project (Bachelors) 2021-22		100										

Materials Science and Engineering 2021-22												
New and Sustainable Product Design 2021-22												
Signal Processing and System Identification 2021-22												
State-Space Control 2021-22		50										

	37	38	39	40	41	42	43	44	45	46	47	48
Advanced Manufacturing Processes and Systems 2021-22												
Combustion, Fuels and Energy 2021-22												
Computational Fluid Dynamics 2021-22												
Energy Systems and Conversion 2021-22												
Finite Element Analysis 2021-22												
Individual Project (Bachelors) 2021-22												
Materials Science and Engineering 2021-22												
New and Sustainable Product Design 2021-22												
Signal Processing and System Identification 2021-22												
State-Space Control 2021-22												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Advanced Manufacturing Processes and Systems 2021-22						75
Combustion, Fuels and Energy 2021-22						40
Computational Fluid Dynamics 2021-22						
Energy Systems and Conversion 2021-22						75
Finite Element Analysis 2021-22						
Individual Project (Bachelors) 2021-22						

Materials Science and Engineering 2021-22						75
New and Sustainable Product Design 2021-22						50
Signal Processing and System Identification 2021-22						75
State-Space Control 2021-22						50

Appendix III - Benchmark Analysis

This table maps programme learning outcomes to relevant QAA subject benchmark statements or PSRB guidelines.

Knowledge and Understanding

	Engin01	Engin02	Engin03	Engin04	Engin05	Engin06	Engin07	Engin08	Engin09
PO1	✓								
PO2		✓							
PO3									
PO4									
PO5									
PO6									

	Engin10	Engin11	Engin12	Engin13	Engin14	Engin15	Engin16	Engin17	Engin18
PO1									
PO2									
PO3		✓							
PO4					✓	✓			
PO5							✓		✓
PO6								✓	

	Engin19	Engin20	Engin21	Engin22	Engin23	Engin24	Engin25	Engin26	MEng01
PO1									
PO2									
PO3									
PO4									
PO5									
PO6									

	MEng02	MEng03	MEng04	MEng05	MEng06	MEng07	MEng08	MEng09	MEng10
PO1									

PO2									
PO3									
PO4									
PO5									
PO6									

	MEng11	MEng12	MEng13	MEng14	MEng15	MEng16	MEng17	MEng18	MEng19
PO1									
PO2									
PO3									
PO4									
PO5									
PO6									

	MEng20	MEng21	MEng22	MEng23	MEng24	MEng25	MEng26	MEng27	MEng28
PO1									
PO2									
PO3									
PO4									
PO5									
PO6									

	MEng29	MEng30	MEng31	MEng32	MEng33	MEng34
PO1						
PO2						
PO3						
PO4						
PO5						
PO6						

Subject Specific Intellectual Skills

	Engin01	Engin02	Engin03	Engin04	Engin05	Engin06	Engin07	Engin08	Engin09
PO7				✓					
PO8			✓						
PO9					✓				
PO10							✓	✓	
PO11									
PO12									

	Engin10	Engin11	Engin12	Engin13	Engin14	Engin15	Engin16	Engin17	Engin18
PO7									
PO8									
PO9									
PO10									
PO11									
PO12		✓							

	Engin19	Engin20	Engin21	Engin22	Engin23	Engin24	Engin25	Engin26	MEng01
PO7									
PO8			✓						
PO9									
PO10									
PO11								✓	
PO12									

	MEng02	MEng03	MEng04	MEng05	MEng06	MEng07	MEng08	MEng09	MEng10
PO7									
PO8									
PO9									
PO10									
PO11									
PO12									

	MEng11	MEng12	MEng13	MEng14	MEng15	MEng16	MEng17	MEng18	MEng19

PO7									
PO8									
PO9									
PO10									
PO11									
PO12									

	MEng20	MEng21	MEng22	MEng23	MEng24	MEng25	MEng26	MEng27	MEng28
PO7									
PO8									
PO9									
PO10									
PO11									
PO12									

	MEng29	MEng30	MEng31	MEng32	MEng33	MEng34
PO7						
PO8						
PO9						
PO10						
PO11						
PO12						

Subject Specific Practical Skills

	Engin01	Engin02	Engin03	Engin04	Engin05	Engin06	Engin07	Engin08	Engin09
PO13									✓
PO14									
PO15					✓				
PO16						✓			
PO17									

PO18									
PO19									

	Engin10	Engin11	Engin12	Engin13	Engin14	Engin15	Engin16	Engin17	Engin18
PO13			✓						
PO14									
PO15									
PO16									
PO17									
PO18	✓			✓					
PO19									

	Engin19	Engin20	Engin21	Engin22	Engin23	Engin24	Engin25	Engin26	MEng01
PO13									
PO14		✓							
PO15									
PO16									
PO17				✓					
PO18	✓								
PO19					✓	✓	✓		

	MEng02	MEng03	MEng04	MEng05	MEng06	MEng07	MEng08	MEng09	MEng10
PO13									
PO14									
PO15									
PO16									
PO17									
PO18									
PO19									

	MEng11	MEng12	MEng13	MEng14	MEng15	MEng16	MEng17	MEng18	MEng19
PO13									
PO14									

PO15									
PO16									
PO17									
PO18									
PO19									

	MEng20	MEng21	MEng22	MEng23	MEng24	MEng25	MEng26	MEng27	MEng28
PO13									
PO14									
PO15									
PO16									
PO17									
PO18									
PO19									

	MEng29	MEng30	MEng31	MEng32	MEng33	MEng34
PO13						
PO14						
PO15						
PO16						
PO17						
PO18						
PO19						

Transferable Skills and Attributes

	Engin01	Engin02	Engin03	Engin04	Engin05	Engin06	Engin07	Engin08	Engin09
PO20									
PO21									
PO22									
PO23									

PO24									
PO25									
PO26									

	Engin10	Engin11	Engin12	Engin13	Engin14	Engin15	Engin16	Engin17	Engin18
PO20									
PO21									
PO22									
PO23									
PO24									
PO25									
PO26									✓

	Engin19	Engin20	Engin21	Engin22	Engin23	Engin24	Engin25	Engin26	MEng01
PO20									
PO21									
PO22									
PO23									
PO24									
PO25									
PO26									

	MEng02	MEng03	MEng04	MEng05	MEng06	MEng07	MEng08	MEng09	MEng10
PO20									
PO21									
PO22									
PO23									
PO24									
PO25									
PO26									

	MEng11	MEng12	MEng13	MEng14	MEng15	MEng16	MEng17	MEng18	MEng19
PO20									

PO21									
PO22									
PO23									
PO24									
PO25									
PO26									

	MEng20	MEng21	MEng22	MEng23	MEng24	MEng25	MEng26	MEng27	MEng28
PO20									
PO21									
PO22									
PO23									
PO24									
PO25							✓		
PO26									

	MEng29	MEng30	MEng31	MEng32	MEng33	MEng34
PO20						
PO21						
PO22						✓
PO23	✓					
PO24				✓		
PO25						
PO26						

Appendix IV:
Benchmark Benchmark Statement(s)

Engin01 - *Knowledge and understanding of scientific principles and methodology necessary to underpin their education in mechanical and related engineering disciplines, to enable appreciation of its scientific and engineering context and to support their...*

Engin02 - *Knowledge and understanding of mathematical principles necessary to underpin their education in mechanical and related engineering disciplines and to enable them to apply mathematical methods, tools and notations proficiently in the analysis and...*

Engin03 - *Ability to apply and integrate knowledge and understanding of other engineering disciplines to support the study of mechanical and related engineering disciplines.*

Engin04 - *Understanding of engineering principles and the ability to apply them to analyse key engineering processes.*

Engin05 - *Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques.*

Engin06 - *Ability to apply quantitative methods and computer software relevant to mechanical and related engineering disciplines, to solve engineering problems.*

Engin07 - *Understanding of and ability to apply a systems approach to engineering problems.*

Engin08 - *Investigate and define a problem and identify constrains including environmental and sustainability limitations, health and safety and risk assessment issues.*

Engin09 - *Understand customer and user needs and the importance of considerations such as aesthetics.*

Engin10 - *Identify and manage cost drivers.*

Engin11 - *Use creativity to establish innovative solutions.*

Engin12 - *Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal.*

Engin13 - *Manage the design process and evaluate outcomes.*

Engin14 - *Knowledge and understanding of commercial and economic context of engineering processes.*

Engin15 - *Knowledge of management techniques which may be used to achieve engineering objectives within that context.*

Engin16 - *Understanding of the requirement for engineering activities to promote sustainable development.*

Engin17 - *Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues.*

Engin18 - *Understanding of the need for a high level of professional and ethical conduct in engineering.*

Engin19 - *Knowledge of characteristics of particular equipment, processes or products.*

Engin20 - *Engineering workshop and laboratory skills.*

Engin21 - *Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology, development, etc)*

Engin22 - *Understanding use of technical literature and other information sources.*

Engin23 - *Awareness of nature of intellectual property and contractual issues.*

Engin24 - *Understanding of appropriate codes of practice and industry standards.*

Engin25 - *Awareness of quality issues.*

Engin26 - *Ability to work with technical uncertainty.*

MEng01 - *A systematic understanding of knowledge, and a critical awareness of current problems and/or new insights, much of which is at, or informed by, the forefront of their academic discipline, field of study, or area of professional practice.*

MEng02 - *A comprehensive understanding of techniques applicable to their own research or advanced scholarship.*

MEng03 - *Originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline.*

MEng04 - *Conceptual understanding that enables the student. To evaluate critically current research and advanced scholarship in the disciplineAnd. To evaluate methodologies and develop critiques of them and, where appropriate, to propose new hypotheses*

MEng05 - *Able to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences.*

MEng06 - *Demonstrate self-direction and originality in tackling and solving problems, and act autonomously in planning and implementing tasks at a professional or equivalent level.*

MEng07 - *Continue to advance their knowledge and understanding, and to develop new skills to a high level.*

MEng08 - *The qualities and transferable skills necessary for employment requiring. The exercise of initiative and personal responsibility. Decision-making in complex and unpredictable situations ...*

MEng09 - *Have a comprehensive knowledge and understanding of mathematical models relevant to*

the engineering discipline, and an appreciation of their limitations.

MEng10 - *Have a comprehensive understanding of the scientific principles of own specialisation and related disciplines.*

MEng11 - *Have a comprehensive knowledge and understanding of the role and limitations of ITC, and an awareness of developing technologies in ITC.*

MEng12 - *Have a wide knowledge and comprehensive understanding of the design process and the ability to apply and adapt the techniques in unfamiliar situations.*

MEng13 - *Have extensive knowledge and understanding of a wide range of engineering materials and components.*

MEng14 - *Have extensive knowledge and understanding of management and business practices, and their limitations, and can apply appropriately.*

MEng15 - *Have a thorough understanding of current practice and its limitations, and some appreciation of likely new developments.*

MEng16 - *Have an understanding of concepts from a range of areas including some outside engineering, and the ability to apply them effectively in technical and business decisions.*

MEng17 - *Have a comprehensive understanding of design methodologies related to their discipline and the ability to apply and adapt them in unfamiliar situations.*

MEng18 - *Have an understanding of the capabilities of computer based models for solving problems in engineering, and the ability to assess the limitations of particular cases.*

MEng19 - *Have the ability to make general evaluations of commercial risks through some understanding of the basis of such risks.*

MEng20 - *Able to use fundamental knowledge to investigate new and emerging technologies.*

MEng21 - *Able to extract, from given data, that which is pertinent to an unfamiliar problem, and apply in its solution, using computer based engineering tools when appropriate.*

MEng22 - *Able to select appropriate data from a range of possible data sets and present them in alternative forms to create deeper understanding and/or greater impact.*

MEng23 - *Able to generate an innovative design for systems, components or processes to fulfil new needs.*

MEng24 - *Able to integrate presentational techniques and the information to be presented for maximum impact.*

MEng25 - *Able to integrate knowledge of mathematics, science, information technology, design, business context and engineering practice to solve a substantial range of engineering problems, some of a complex nature, apply understanding to novel and...*

MEng26 - *Able to apply engineering techniques taking account of a range of commercial and industrial constraints.*

MEng27 - *Able to research and use new methods required for novel situations and adapt to specific purposes if necessary.*

MEng28 - *Able to recognise the capabilities and limitations of computer based methods for engineering problem solving, have some awareness of the future developments of IT tools, and formulate and anticipate needs.*

MEng29 - *Able to learn new theories, concepts, methods etc in an unfamiliar situation outside the discipline area.*

MEng30 - *Able to be innovative in the use of a broad range of scientific principles in solving engineering problems.*

MEng31 - *Able to generate ideas for new products and develop and evaluate a range of new solutions.*

MEng32 - *Able to develop, monitor and update a plan, to reflect a changing operating environment.*

MEng33 - *Able to monitor and adjust a personal programme of work on an on-going basis and can learn independently.*

MEng34 - *Able to undertake most of the technical roles within a team and can exercise leadership.*