UNIVERSITY OF LINCOLN

Programme Specification

Title:

Electrical Engineering (Power and Energy)

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: 1 Oct 2015

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:	Electrical Engineering (Power and Energy)
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?	
UCAS code	H106
Awarding Body	University of Lincoln
Campus(es)	Lincoln Campus
School(s)	School of Engineering
Programme Leader	Saket Srivastava (ssrivastava)
Relevant Subject Benchmark Statements	
Professional, Statutory or Regulatory Body Accreditation	Institution of Engineering and Technology (IET)
Programme Start Date	2019-20

3. Programme Description

3.1 Overview

Electrical Engineering influences many aspects of our life ranging from energy, healthcare, entertainment and commerce, to communications, manufacturing and the environment. An Electrical 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 challenging problems in a wide range of industries, including the power sector and the electronics industry.

With this in mind the Electrical Engineering (Power & Energy) curriculum has been developed to provide a specialised electrical engineering education targeting power and energy (P&E) systems, to 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.? During the second year, students get a first exposure towards P&E stream when they undertake a stream focussed group project in Design Engineering module. Students get to further consolidate their practical knowledge in P&E while undertaking an Individual Project module during the third year of studies.

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 electrical 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 electrical 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 electrical 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 electrical engineering, with knowledge of current practice in selected areas of engineering (electronics, 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 electrical 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 electrical engineering. It is conducted under the supervision 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 throughout 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
Mathematics for Engineers 2019-20	15	Core
Professional and Workshop Skills 2019-20	15	Core
Computing for Engineers 2019-20	15	Core
Electrical and Electronic Technology 2019-20	15	Core
Semiconductor Device Physics 2019-20	15	Core
Introduction to Robotics 2019-20	15	Core
Electricity and Electromagnetism 2019-20	15	Core
Statics and Dynamics 2019-20	15	Core

Level 2

Title	Credit Rating	Core / Optional
Control Systems 2020-21	15	Core
Industrial Engineering 2020-21	15	Core
Electrical Power and Machines 2020-21	15	Core
Further Mathematics for Engineers 2020-21	15	Core
Design Engineering 2020-21	15	Core
Digital Systems and Microprocessors 2020-21	15	Core
Analogue Electronics 2020-21	15	Core
Mechatronics 2020-21	15	Core

Level 3

Title	Credit Rating	Core / Optional
Signal Processing and System Identification 2021-22	15	Optional
Power Generation and Transmission 2021-22	15	Core
Individual Project (Bachelors) 2021-22	30	Core
Energy Systems and Conversion 2021-22	15	Core
State-Space Control 2021-22	15	Optional
Power Electronics 2021-22	15	Core
Communication Systems 2021-22	15	Core
Programmable Logic Design 2021-22	15	Optional
Robotics and Automation 2021-22	15	Optional
Electrical Machine Design 2021-22	15	Core
Smart Electronics 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
Computing for Engineers 2019-20	✓								✓			
Electrical and Electronic Technology 2019-20	✓						✓		✓			
Electricity and Electromagnetism 2019-20	✓	✓										
Introduction to Robotics 2019-20	✓	✓				✓		✓	✓			✓
Mathematics for Engineers 2019-20	✓	✓					✓			✓		
Professional and Workshop Skills 2019-20				✓	✓							
Semiconductor Device Physics 2019-20	✓											
Statics and Dynamics 2019-20	✓	✓								✓		

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
Computing for Engineers 2019-20				✓	✓			✓				
Electrical and Electronic Technology 2019-20		✓		✓				✓	✓	✓	✓	
Electricity and Electromagnetism 2019-20											✓	
Introduction to Robotics 2019-20		✓		✓	✓							
Mathematics for Engineers 2019-20											✓	
Professional and Workshop Skills 2019-20		✓	✓					✓	✓	✓		
Semiconductor Device Physics 2019-20		✓									✓	
Statics and Dynamics 2019-20		✓									✓	

	PO25	PO26
Computing for Engineers 2019-20		
Electrical and Electronic Technology 2019-20		
Electricity and Electromagnetism 2019-20		

Introduction to Robotics 2019-20		
Mathematics for Engineers 2019-20		
Professional and Workshop Skills 2019-20		
Semiconductor Device Physics 2019-20		
Statics and Dynamics 2019-20		

Level 2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Analogue Electronics 2020-21	✓	✓					✓	✓	✓			
Control Systems 2020-21	✓	✓					✓	✓	✓	✓		
Design Engineering 2020-21			✓	✓	✓	✓			✓			
Digital Systems and Microprocessors 2020-21	✓	✓					✓	✓	✓			
Electrical Power and Machines 2020-21	✓	✓					✓	✓				
Further Mathematics for Engineers 2020-21	✓	✓					✓	✓				
Industrial Engineering 2020-21				✓	✓	✓						
Mechatronics 2020-21	✓	✓					✓	✓	✓			

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
Analogue Electronics 2020-21	✓	✓		✓							✓	
Control Systems 2020-21		✓					✓					✓
Design Engineering 2020-21	✓							✓	✓	✓		
Digital Systems and Microprocessors 2020-21		✓		✓							✓	✓
Electrical Power and Machines 2020-21		✓					✓					✓
Further Mathematics for Engineers 2020-21									✓		✓	
Industrial Engineering 2020-21								✓	✓			
Mechatronics 2020-21	✓	✓		✓	✓					✓	✓	

	PO25	PO26

Analogue Electronics 2020-21		
Control Systems 2020-21	✓	
Design Engineering 2020-21		
Digital Systems and Microprocessors 2020-21	✓	
Electrical Power and Machines 2020-21	✓	
Further Mathematics for Engineers 2020-21	✓	
Industrial Engineering 2020-21		
Mechatronics 2020-21	✓	

Level 3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Communication Systems 2021-22	✓	✓					✓	✓	✓			
Electrical Machine Design 2021-22	✓		✓				✓	✓	✓	✓		
Energy Systems and Conversion 2021-22	✓	✓					✓	✓	✓			
Individual Project (Bachelors) 2021-22	✓		✓		✓		✓	✓	✓	✓	✓	✓
Power Electronics 2021-22	✓	✓					✓	✓	✓			
Power Generation and Transmission 2021-22	✓	✓					✓	✓	✓	✓		
Programmable Logic Design 2021-22	✓		✓				✓	✓	✓			
Robotics and Automation 2021-22	✓	✓	✓				✓	✓	✓			
Signal Processing and System Identification 2021-22	✓	✓					✓	✓	✓	✓		
Smart Electronics 2021-22												
State-Space Control 2021-22	✓	✓					✓	✓	✓	✓		

	PO13	PO14	PO15	PO16	PO17	PO18	PO19	PO20	PO21	PO22	PO23	PO24
Communication Systems 2021-22		✓		✓	✓					✓	✓	
Electrical Machine Design 2021-22	✓	✓		✓	✓					✓	✓	
Energy Systems and Conversion 2021-22			✓						✓			
Individual Project (Bachelors) 2021-22	✓		✓		✓	✓	✓	✓	✓		✓	✓
Power Electronics 2021-22		✓		✓						✓	✓	

Power Generation and Transmission 2021-22			✓	✓					✓			
Programmable Logic Design 2021-22	✓	✓		✓	✓				✓	✓	✓	
Robotics and Automation 2021-22		✓		✓	✓				✓	✓	✓	
Signal Processing and System Identification 2021-22			✓	✓					✓			
Smart Electronics 2021-22												
State-Space Control 2021-22			✓	✓					✓			

	PO25	PO26
Communication Systems 2021-22		
Electrical Machine Design 2021-22		
Energy Systems and Conversion 2021-22	✓	
Individual Project (Bachelors) 2021-22	✓	
Power Electronics 2021-22		
Power Generation and Transmission 2021-22	✓	
Programmable Logic Design 2021-22	✓	
Robotics and Automation 2021-22	✓	
Signal Processing and System Identification 2021-22	✓	
Smart Electronics 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
Computing for Engineers 2019-20												
Electrical and Electronic Technology 2019-20												
Electricity and Electromagnetism 2019-20												
Introduction to Robotics 2019-20												
Mathematics for Engineers 2019-20					25							
Professional and Workshop Skills 2019-20												
Semiconductor Device Physics 2019-20												
Statics and Dynamics 2019-20												

	13	14	15	16	17	18	19	20	21	22	23	24
Computing for Engineers 2019-20							100					
Electrical and Electronic Technology 2019-20							100					
Electricity and Electromagnetism 2019-20			25									
Introduction to Robotics 2019-20												
Mathematics for Engineers 2019-20												
Professional and Workshop Skills 2019-20												
Semiconductor Device Physics 2019-20									25			
Statics and Dynamics 2019-20												

	25	26	27	28	29	30	31	32	33	34	35	36
Computing for Engineers 2019-20												
Electrical and Electronic Technology 2019-20												
Electricity and Electromagnetism 2019-20												
Introduction to Robotics 2019-20		100										
Mathematics for Engineers 2019-20												

Professional and Workshop Skills 2019-20	100											
Semiconductor Device Physics 2019-20												
Statics and Dynamics 2019-20			25									

	37	38	39	40	41	42	43	44	45	46	47	48
Computing for Engineers 2019-20												
Electrical and Electronic Technology 2019-20												
Electricity and Electromagnetism 2019-20												
Introduction to Robotics 2019-20												
Mathematics for Engineers 2019-20												
Professional and Workshop Skills 2019-20												
Semiconductor Device Physics 2019-20												
Statics and Dynamics 2019-20												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Computing for Engineers 2019-20						
Electrical and Electronic Technology 2019-20						
Electricity and Electromagnetism 2019-20						75
Introduction to Robotics 2019-20						
Mathematics for Engineers 2019-20						75
Professional and Workshop Skills 2019-20						
Semiconductor Device Physics 2019-20						75
Statics and Dynamics 2019-20						75

Level 2

	01	02	03	04	05	06	07	08	09	10	11	12

Analogue Electronics 2020-21												
Control Systems 2020-21												
Design Engineering 2020-21												
Digital Systems and Microprocessors 2020-21												
Electrical Power and Machines 2020-21												
Further Mathematics for Engineers 2020-21			25									
Industrial Engineering 2020-21									25			
Mechatronics 2020-21												

	13	14	15	16	17	18	19	20	21	22	23	24
Analogue Electronics 2020-21								25				
Control Systems 2020-21					50							
Design Engineering 2020-21												
Digital Systems and Microprocessors 2020-21											50	
Electrical Power and Machines 2020-21												
Further Mathematics for Engineers 2020-21												
Industrial Engineering 2020-21												
Mechatronics 2020-21												

	25	26	27	28	29	30	31	32	33	34	35	36
Analogue Electronics 2020-21												
Control Systems 2020-21												
Design Engineering 2020-21	100											
Digital Systems and Microprocessors 2020-21												
Electrical Power and Machines 2020-21	25											
Further Mathematics for Engineers 2020-21												
Industrial Engineering 2020-21												
Mechatronics 2020-21				40								

	37	38	39	40	41	42	43	44	45	46	47	48

Analogue Electronics 2020-21												
Control Systems 2020-21												
Design Engineering 2020-21												
Digital Systems and Microprocessors 2020-21												
Electrical Power and Machines 2020-21												
Further Mathematics for Engineers 2020-21												
Industrial Engineering 2020-21												
Mechatronics 2020-21												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Analogue Electronics 2020-21						75
Control Systems 2020-21						50
Design Engineering 2020-21						
Digital Systems and Microprocessors 2020-21						50
Electrical Power and Machines 2020-21						75
Further Mathematics for Engineers 2020-21						75
Industrial Engineering 2020-21						75
Mechatronics 2020-21						60

Level 3

	01	02	03	04	05	06	07	08	09	10	11	12
Communication Systems 2021-22												
Electrical Machine Design 2021-22												
Energy Systems and Conversion 2021-22												
Individual Project (Bachelors) 2021-22												

Power Electronics 2021-22												
Power Generation and Transmission 2021-22												
Programmable Logic Design 2021-22												
Robotics and Automation 2021-22												
Signal Processing and System Identification 2021-22												
Smart Electronics 2021-22												
State-Space Control 2021-22												

	13	14	15	16	17	18	19	20	21	22	23	24
Communication Systems 2021-22										25		
Electrical Machine Design 2021-22												25
Energy Systems and Conversion 2021-22												
Individual Project (Bachelors) 2021-22												
Power Electronics 2021-22										25		
Power Generation and Transmission 2021-22												25
Programmable Logic Design 2021-22											70	
Robotics and Automation 2021-22								25				
Signal Processing and System Identification 2021-22						25						
Smart Electronics 2021-22												
State-Space Control 2021-22												

	25	26	27	28	29	30	31	32	33	34	35	36
Communication Systems 2021-22												
Electrical Machine Design 2021-22												
Energy Systems and Conversion 2021-22		25										
Individual Project (Bachelors) 2021-22		100										
Power Electronics 2021-22												
Power Generation and Transmission 2021-22												
Programmable Logic Design 2021-22												
Robotics and Automation 2021-22												
Signal Processing and System Identification												

2021-22												
Smart Electronics 2021-22	100											
State-Space Control 2021-22		50										

	37	38	39	40	41	42	43	44	45	46	47	48
Communication Systems 2021-22												
Electrical Machine Design 2021-22												
Energy Systems and Conversion 2021-22												
Individual Project (Bachelors) 2021-22												
Power Electronics 2021-22												
Power Generation and Transmission 2021-22												
Programmable Logic Design 2021-22												
Robotics and Automation 2021-22												
Signal Processing and System Identification 2021-22												
Smart Electronics 2021-22												
State-Space Control 2021-22												

	49	50	51	52	EP 1 (Wk 16)	EP 2 (Wks 33, 34, 35)
Communication Systems 2021-22						75
Electrical Machine Design 2021-22						75
Energy Systems and Conversion 2021-22						75
Individual Project (Bachelors) 2021-22						
Power Electronics 2021-22						75
Power Generation and Transmission 2021-22						75
Programmable Logic Design 2021-22						30
Robotics and Automation 2021-22						75
Signal Processing and System Identification 2021-22						75
Smart Electronics 2021-22						

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
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
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
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
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.*