UNIVERSITY OF LINCOLN

Programme Specification

Title:

Automation 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: 1 Sep 2016

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:	Automation 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 Distance Learning
Is there a Placement or Exchange?	No
UCAS code	H660
Awarding Body	University of Lincoln
Campus(es)	Lincoln Campus
School(s)	School of Engineering
Programme Leader	Andrea Paoli (APaoli)
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

This programme aims at producing professionals who can actively participate and take the lead in the executive design and development of automation systems, and who may take on full responsibility for installing, testing and maintaining complex machines and systems.

The Automation Engineer, thanks to the interdisciplinary nature of the curriculum, will be able to design or manage systems resulting from the integration of highly diverse components and technologies. This flexibility and multidisciplinary competences will be a significant asset of the automation engineer, in view of the large variety of possible applications, of the continuous and rapid evolution of the technologies, as well as of the dynamics of the job market.

In this regard, the objective of this programme is to provide graduate students with a strong background in fundamental scientific disciplines, such as Mathematics and Computing Systems, in classical engineering fields from the Mechanical and Electrical Engineering sectors, and in the disciplines of information and telecommunication applied to industrial automation.

By studying this programme, you will be joining a vibrant community, benefitting from the cutting-edge research conducted by leading academics based within the School of Engineering. Also, you will be exposed to the latest technologies, tools and industrial practices thanks to the many collaborations with world-leading corporations in the automation engineering sector. The international background of the School and the partnership with companies that operate on the global market are a guarantee of the international reputation of the programme, ensuring that our graduate profiles receive a broad appreciation worldwide.

The Building Control stream is designed to provide students with specific knowledge from the Building Automation sector. During the second year, students get a first exposure towards Building Management Systems (BMS) stream when they undertake a stream focused group project in the Design Engineering module. Students get to further consolidate their practical knowledge in BMS while undertaking an Individual Project module during the third year of studies.

Schneider Electric (global building automation company) share with the School of Engineering this vision of producing graduates with a strong academic background who are ready to enter cutting edge industry as “industry ready graduates”. In light of this common objective they have strongly contributed in informing this unique programme that will provide extensive and rewarding opportunities for graduates whilst helping the sector address a key skills gap which is currently limiting its competitiveness.

The accreditation by the Institution of Engineering and Technology (IET) professional body will be sought in the next year. In this regard, the programme has been designed to be compliant with the IET requirements for accreditation.

3.2 Aims and Objectives

The overall aim of this programme is to create graduates who will be aligned with the needs of organizations in the building automation sector. The first two years of study will lay the common foundations of automation engineering principles. The final year will provide an opportunity for students to deepen their learning through engagement with a substantial project linked to their own industries.

The overall aims of the programme will be:

- To produce graduates who are prepared for a career in the Building Automation sector as a Control Systems or Automation Engineer;
- To provide a broad knowledge and understanding of modern Building Management Systems that is informed by the industrial state of the art and best practices;
- To provide a broad knowledge and understanding of automation engineering that is informed by the research activities of the academic staff and by the industrial best practices and standards;
- To produce graduates who can apply fundamental scientific principles and mathematical techniques in order to design innovative Building Management Systems;
- To offer an industrially relevant degree programme that places the student’s learning experience at the centre of every activity;
- 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.

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 automation engineering science applied to Building Management Systems design.

2 The mathematical concepts and principles that are relevant to analyse, design, validate, implement and maintain complex Building Automation Systems.

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 the automation engineer operate, including industry standards and codes of practice in the Building Management sector.

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, and design and business practice to propose solutions to engineering problems in the field of Building Automation.

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 complex Building Management 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 Building Automation solutions 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 in the Building Automation sector using a wide range of technical and other literature.

16 Use commercial computer software to analyse and design Building Management Systems.

17 Write computer programmes to analyse data.

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 automation 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.

The School will make the maximum use of the link with Schneider Electric as well as the 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. In other words students will be engaged with, and have ownership over, the production of their own educational experience by working in collaboration with academics and key people from the industry. An example of this learning and teaching philosophy is the level 2 Design Engineering module which 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 School 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.

In addition, students can benefit from the Personal Development Planning (PDP) scheme, i.e. the process by which they 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.

5.2. 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
Introduction to Robotics 2019-20	15	Core
Mathematics for Engineers 2019-20	15	Core
Computing for Engineers 2019-20	15	Core
CAD and Technical Drawing 2019-20	15	Core
Professional and Workshop Skills 2019-20	15	Core
Statics and Dynamics 2019-20	15	Core
Electricity and Electromagnetism 2019-20	15	Core
Electrical and Electronic Technology 2019-20	15	Core

Level 2

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

Level 3

Title	Credit Rating	Core / Optional
Industrial Automation 2021-22	15	Core
State-Space Control 2021-22	15	Core
Building Automation Systems 2021-22	15	Core
Robotics and Automation 2021-22	15	Core
Energy Systems and Conversion 2021-22	15	Core
Signal Processing and System Identification 2021-22	15	Core
Individual Project (Bachelors) 2021-22	30	Core

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	✓						✓		✓			
Electricity and Electromagnetism 2019-20	✓	✓										
Introduction to Robotics 2019-20	✓	✓				✓		✓	✓			✓
Mathematics for Engineers 2019-20	✓	✓					✓			✓		
Professional and Workshop Skills 2019-20				✓	✓							
Statics and Dynamics 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		✓		✓				✓	✓	✓	✓	
Electricity and Electromagnetism 2019-20											✓	
Introduction to Robotics 2019-20		✓		✓	✓							
Mathematics for Engineers 2019-20											✓	
Professional and Workshop Skills 2019-20		✓	✓					✓	✓	✓		
Statics and Dynamics 2019-20		✓									✓	

	PO25	PO26
CAD and Technical Drawing 2019-20		
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		
Statics and Dynamics 2019-20		

Level 2

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

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

	PO25	PO26
Advanced Thermofluids 2020-21	✓	
Analogue Electronics 2020-21		

Control Systems 2020-21		
Design Engineering 2020-21		
Electrical Power and Machines 2020-21	✓	
Further Mathematics for Engineers 2020-21		
Mechatronics 2020-21	✓	
Solid Body Mechanics 2020-21	✓	

Level 3

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Building Automation Systems 2021-22			✓	✓	✓				✓	✓		✓
Energy Systems and Conversion 2021-22	✓	✓					✓	✓	✓			
Individual Project (Bachelors) 2021-22	✓		✓		✓		✓	✓	✓	✓	✓	✓
Industrial Automation 2021-22	✓	✓							✓	✓		
Robotics and Automation 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
Building Automation Systems 2021-22		✓		✓	✓		✓		✓			
Energy Systems and Conversion 2021-22			✓									
Individual Project (Bachelors) 2021-22	✓		✓		✓	✓	✓	✓	✓		✓	✓
Industrial Automation 2021-22		✓		✓	✓				✓			
Robotics and Automation 2021-22		✓		✓	✓				✓	✓	✓	
Signal Processing and System Identification 2021-22			✓	✓					✓			
State-Space Control 2021-22			✓	✓					✓			

	PO25	PO26
Building Automation Systems 2021-22	✓	

Energy Systems and Conversion 2021-22	✓	
Individual Project (Bachelors) 2021-22	✓	✓
Industrial Automation 2021-22	✓	
Robotics and Automation 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												
Electricity and Electromagnetism 2019-20												
Introduction to Robotics 2019-20												
Mathematics for Engineers 2019-20					25							
Professional and Workshop Skills 2019-20												
Statics and Dynamics 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					
Electricity and Electromagnetism 2019-20			25									
Introduction to Robotics 2019-20												
Mathematics for Engineers 2019-20												
Professional and Workshop Skills 2019-20												
Statics and Dynamics 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												
Electricity and Electromagnetism 2019-20												
Introduction to Robotics 2019-20		100										

Mathematics for Engineers 2019-20												
Professional and Workshop Skills 2019-20	100											
Statics and Dynamics 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												
Electricity and Electromagnetism 2019-20												
Introduction to Robotics 2019-20												
Mathematics for Engineers 2019-20												
Professional and Workshop Skills 2019-20												
Statics and Dynamics 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						
Electricity and Electromagnetism 2019-20						75
Introduction to Robotics 2019-20						
Mathematics for Engineers 2019-20						75
Professional and Workshop Skills 2019-20						
Statics and Dynamics 2019-20						75

Level 2

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

Advanced Thermofluids 2020-21												
Analogue Electronics 2020-21												
Control Systems 2020-21												
Design Engineering 2020-21												
Electrical Power and Machines 2020-21												
Further Mathematics for Engineers 2020-21			25									
Mechatronics 2020-21												
Solid Body Mechanics 2020-21												

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

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

	37	38	39	40	41	42	43	44	45	46	47	48
Advanced Thermofluids 2020-21												
Analogue Electronics 2020-21												
Control Systems 2020-21												

Design Engineering 2020-21												
Electrical Power and Machines 2020-21												
Further Mathematics for Engineers 2020-21												
Mechatronics 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
Analogue Electronics 2020-21						75
Control Systems 2020-21						50
Design Engineering 2020-21						
Electrical Power and Machines 2020-21						75
Further Mathematics for Engineers 2020-21						75
Mechatronics 2020-21						60
Solid Body Mechanics 2020-21						75

Level 3

	01	02	03	04	05	06	07	08	09	10	11	12
Building Automation Systems 2021-22												
Energy Systems and Conversion 2021-22												
Individual Project (Bachelors) 2021-22												
Industrial Automation 2021-22												
Robotics and Automation 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
Building Automation Systems 2021-22						50						
Energy Systems and Conversion 2021-22												
Individual Project (Bachelors) 2021-22												
Industrial Automation 2021-22						30						
Robotics and Automation 2021-22								25				
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
Building Automation Systems 2021-22				50								
Energy Systems and Conversion 2021-22		25										
Individual Project (Bachelors) 2021-22		100										
Industrial Automation 2021-22				30				40				
Robotics and Automation 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
Building Automation Systems 2021-22												
Energy Systems and Conversion 2021-22												
Individual Project (Bachelors) 2021-22												
Industrial Automation 2021-22												
Robotics and Automation 2021-22												
Signal Processing and System Identification 2021-22												
State-Space Control 2021-22												

	49	50	51	52	EP 1 (Wk	EP 2 (Wks

					16)	33, 34, 35)
Building Automation Systems 2021-22						
Energy Systems and Conversion 2021-22						75
Individual Project (Bachelors) 2021-22						
Industrial Automation 2021-22						
Robotics and Automation 2021-22						75
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
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.*