University of BRISTOL

The Systems Centre

The University of Bristol

MRes in Systems

HANDBOOK

2013-2014

Version 2.0

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1 WELCOME AND INTRODUCTION

We would like to extend a very warm welcome to all of you as you commence your studies on the MRes in Systems programme. We are looking forward to working and learning with you over the next two years.

We hope that most of your questions will be answered somewhere in this handbook or in the various guidelines available at the partner universities. If you are not able to find the answer to your query please do not hesitate to contact the Systems centre team, who will be able to point you in the right direction.

The purpose of this handbook is to provide a reference source for participants in the MRes in Systems programme, namely Research Engineers (REs)[1], supervisors and taught unit directors. It has been designed to offer information normally required for the duration of the MRes programme from registration to graduation[2].

Much of the information enclosed within focuses on programme specific information and practical issues; for a comprehensive overview of the Bristol policies and practices, this handbook *must* be read in conjunction with the University's regulations.
It is important to note that REs are subject to the regulations of the University; hard copies of the appropriate regulations will be issued at registration. Alternatively, information about the Universitie's regulations can be found at:

http://www.bris.ac.uk/postgraduates/#Rules

http://www.bris.ac.uk/esu/assessment/#code

REs should familiarise themselves with its contents. As well as providing wider details of the University's research and teaching environment, it includes information concerning RE entitlements and responsibilities, the supervisory process and assessment arrangements.

The Systems Centre Delivery team

[1] Postgraduate research students on the MRes and EngD in Systems programmes are called Research Engineers, or REs.
[2] The information contained in this handbook is correct at the time of publication. Any revisions will be made in hard copy on an annual basis; for the most up to date edition please refer to the Centre's website at: *http://www.bristol.ac.uk/eng-systems-centre/current/*

2 CONTACT DETAILS

For general enquiries please contact the Industrial Doctorate Centre in Systems
http://www.bristol.ac.uk/eng-systems-centre/

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3 OVERVIEW

3.1 The MRes in Systems Qualification

The MRes in Systems programme is a 2-year part-time programme intended for employed graduated engineers, and run in parallel with the Engineering Doctorate (EngD). The MRes in Systems is specially designed for employed engineers, and aimed at developing people who will be capable of leading innovation in their companies. MRes students attend the same taught units as the EngDs at Bristol over the 2 years, and can progress onto the EngD programme, based upon successful completion of MRes. The programme is delivered by a combination of taught coursework and industrial research project work. It can be sponsored by the Company-Employer or Self-funded.

3.2 The Systems Centre

The Systems centre builds upon the University's world-class portfolios in Systems and Management education to provide a unique approach to engineered systems and their management. It offers an innovative environment and culture, underpinned by renowned excellence in industry-collaborative research, world-class expertise and resources and an holistic, multidisciplinary approach which gives equal emphasis to 'soft'(human) and 'hard' (physical) systems.

The Systems Centre hosts the Industrial Doctorate Centre and offers both a physical location and Internet facilities, including e-learning and video conferencing. The Systems Centre is located in the Merchant Venturers Building at Bristol University (**Annex1)** provides an arena for networking and interacting with the wider Systems community, as well as teaching and hot-desking facilities. The Systems Centre facilitates a programme of Systems research seminars, and Systems EngD conferences for all REs and their supervisors, and a series of public lectures, named after the leader of Systems Thinking in Bristol, Professor David Blockley. These lectures are delivered by prominent speakers, throughout the academic year.

4 PROGRAMME DETAILS

4.1 Overview

REs carry out their research in collaboration with their employer and with the University; the taught component of the programme is co-ordinated by the centre and delivered at the University of Bristol. The taught programme features three distinct streams

i) Systems Engineering, covering generic system engineering material;
ii) Research Methods, covering generic and systems specific research methodology;
iii) Specialist, covering material specific to the RE's interests.

For reference, the full Programme Specification is available from the Education Support Unit website:

http://www.bristol.ac.uk/esu/unitprogcat/RouteStructureCohort.jsa;jsessionid=B5C5DCD519D26ECE7E6BCBBCB14D7955.nAC1004052063?byCohort=Y&cohort=Y&routeLevelCode=2&modeOfStudyCode=Part+Time&ayrCode=12%2F13&programmeCode=4CIVE010T

4.2 The Research Project

The Research Project is undertaken as a partnership between the Collaborating Company and the Systems Centre when a Company sponsors the RE. Although MRes in Systems is a post graduate taught degree, the research project dissertation constitutes 100 credit points (cp) out of 180 cp of the whole degree. The MRes in Systems programme is constructed in such way that a specialised knowledge from the taught component of the programme will be applied to an industrial research project at Masters level, to inform and develop research design and execution.

4.3 Supervision

The RE is supervised by an Industrial Supervisor (from the Collaborating Company), and a principal Academic Supervisor.

The supervisors oversee the development of the RE and provide advice and support for the Research Project. Together with the RE, they identify the knowledge and skills that the RE should develop and they advise on appropriate units, ensuring that the optional element of the taught programme and professional development is tailored to the RE's needs.

It is REs responsibility to maintain regular contact with the academic and industrial supervisors. The nature of this contact will vary, dependent on the practices of the individuals involved, and the nature of the project work. As a guide, RE should ensure that you make contact with both supervisors at least once a fortnight – this may be in the form of a face-to-face meeting, telephone meeting, or e-mail correspondence.

Industrial Supervisor

The Industrial Supervisor will provide the main point of contact with the Collaborating Company and will normally be the line manager directing the Research Project. The Industrial Supervisor will help progress the project within the company, ensuring the project remains pertinent to the company's needs and that the RE has the opportunity to apply the knowledge gained from the taught EngD units.

The Industrial Supervisor will have experience of professional and career development and have technical or managerial knowledge of the industrial problem to be addressed by the RE.

Principal Academic Supervisor

The principal Academic Supervisor will be an expert in the field of the Research Project and will ensure that the academic content and standard of the project work meet the requirements of the doctorate degree. The principal Academic Supervisor will also ensure that the RE has a wide awareness of the subject area of the research and that there is sufficient depth of understanding and analysis within the RE's project reports and EngD dissertation. The principal Academic Supervisor will provide adequate guidance to support all academic activities of the RE, specific to postgraduate education – conference attendance, publications in peer reviewed journals, presentations of research etc.

An analysis of supervisory roles is given in **Annex 5**.

4.4. Taught Masters Level Units

REs will take the taught component over the two years of the programme to enable them to apply the knowledge and insights gained to their research work. The taught component consists of 6 core (i.e. mandatory) units and one elective unit. The programme specification is shown in **Annex 3**.

RE must complete a total of 80 credits of taught coursework to satisfy the taught element of the programme. Each credit point represents 10 hours of effort for a typical RE. Exemptions for accredited prior learning (APL) must be approved by the Programme Director and the Postgraduate Studies Committee (PGSC).

Core Units [3]
All core units are delivered as short courses of up to five days. Details of core units are given in **Annex 2**.

It is recommended that the core units are taken in the order shown below:

1. Problem Structuring and Research Methods
2. Systems Engineering
3. Mathematics for Systems
4. Complex Systems Design
5. Socio-Technical Systems
6. Integrating Engineering and Management Systems

Elective Unit
One elective unit should be taken at Masters level. The choice of elective should be discussed and agreed with the RE's Supervisors and the Programme Director.

The RE is responsible for registering for their elective unit with the department/school/establishment delivering that unit and for establishing unit timetables. REs should contact the Programme Administrator for further advice.

4.5 Attending Units

REs must attend all lectures, workshops, seminars and classes delivered as part of the taught programme. This provides REs with the opportunity to network with Systems Engineers from other disciplines and companies and to discuss their research with their academic supervisors.

5 Assessment

Note: A programme-specific details are presented in this section. For full details on the University regulations for a Taught component of the EngD in Systems, please refer to:

- University of Bristol Code of Practice for Post Graduate Taught programmes 2013-2014: http://www.bris.ac.uk/esu/assessment/codeonline.html#extcircs

[3] Please note that the content of core units may change to suit the requirements of industry, in response to feedback from REs and to reflect developments in the fields of the units.

5.1 Mandatory taught units

Taught units will be assessed using a variety of methods including coursework assignments, examination, reflective learning logs and peer review as well as the final dissertation. Specific details can be found in **Annex 2** and in the relevant Programme Specification. The pass mark for the units is 50% .

- The RE is responsible for ascertaining the assessment method for all core and elective units and times of all unit examinations, where appropriate.
- The RE is responsible for bringing any clashes in examination times to the attention of the Programme Coordinator and Programme Director so that any issues can be resolved

5.2 Submission of assignments

The assignment must be submitted to the Blackboard by the stipulated date/time. By submitting the assignment you are accepting the Plagiarism Declaration and confirming that the work is original and does not contain any plagiarised material. Instructions on how to submit will be provided in detail at the first unit (Research Methods 1).
Each assignment report should be typed in 10 to 12 point font, guidelines for the format and presentation of assignments and reports can be found on Blackboard.

Please include a title page with the following information clearly laid out:

- Module title and Code
- Title of assignment
- Name and your student number
- Date of submission
- Word count (excluding appendices)

Please name your assignment document in this way:
Your Name -its.doc Introduction to Systems
Your Name-mfs-daily assign.doc or Smith-mfs-mainassign.doc Mathematics for Systems
Your Name- rm1.doc Research Methods1

All coursework assignments will normally have a specified word limit. The word limit will refer to the main body of the text and so will not include appendices or bibliographies unless specifically stated. You may exceed this word limit only by a maximum of 20%.

Coursework assignment results will normally be returned to the REs within 6 weeks of the submission date. It must be noted that these results remain provisional until confirmed by the Engineering faculty Examination Board.

5.3 Late Submission

The Unit Director may grant an extension to a submission date should there be valid circumstances affecting your ability to meet the deadline.
Note: Extension requests should be made in writing to the Unit Director and copied to the Programme Coordinator detailing the reasons for the extension along with the submission date. These reasons should be endorsed by both supervisors. It is also expected that this request will include any documentary evidence required to support the case made. For example, in the case of illness preventing timely completion of an assignment, it is expected that a request for an extension will be accompanied by a doctor's certificate.

All requests must be made **at least five days** before the deadline. Submission of an extension request does not guarantee agreement to an extension.

If no extension has been granted and a piece of work is submitted after the submission date it will assessed at a maximum of 50%. Any coursework (for which there are no mitigating circumstances or an agreed extension) submitted later than five days after the submission date will normally receive a mark of zero (failed).

5.4 Taught unit results
The MRes Examination Board, which meets annually, is comprised of the Systems centre staff and the external examiner. The Board will consider REs under the regulations of the University of Bristol. The Board will make recommendations to the appropriate committee of the faculty.

5.5 Compensation of Marks
REs will be allowed one resit/re-assessment per unit **up to a maximum of 50% of their total taught credit points**. Compensation, **up to a maximum of 20 credit points** will be applied after a resit has been taken. However, compensation will only be applied to a resit mark of at least 40% for Level M units. Students achieving a resit mark of less than 40% for Level M units will have failed the unit. In addition, students must achieve an overall mark of 50% for the taught component.

The University of Bristol Code of Practice Flow Diagram for a Post Graduate Taught programmes assessment and progressions:
http://www.bris.ac.uk/esu/assessment/annex/progressionflowdiagram.html#pgt

5.6 MRes Dissertation
A generic guidance for PG dissertations is provided on the University website:

http://www.bris.ac.uk/esu/assessment/annex/dissertationguidelines.html

The MRes dissertation is submitted in partial fulfilment of the MRes degree requirements and constitutes 100 cp. Research Engineers must be able to demonstrate that they have applied concepts or used methods taught on the Research Methods and Systems methodologies Units on the chosen research project, relevant to the Company sponsor business case. A dissertation should address a well-defined research question, specified at the outset. It should present a logically developed argument, the claims of which are supported by evidence where necessary.

5.7 Individual Mitigating Circumstances
Individual Mitigating Circumstances (IMCs) refer to conditions or circumstances that either temporarily prevent an RE from undertaking assessment or significantly impair
a RE's performance in assessment. Note that the criterion for IMCs is the impact on the assessment, rather than the impact on the RE.

IMCs are distinct from longer-term conditions or circumstances that affect your ability to study, of the type that might be better supported through, for instance, disability support or special assessment arrangements.

Definitions of IMCs can be found:

- University of Bristol Code of Practice for Post Graduate Taught programmes 2013-2014,
  http://www.bristol.ac.uk/esu/assessment/codeonline.html#extcircs

You should make yourself familiar with these definitions, in addition to any IMC guidance offered by the Universities/Schools and support and guidance offered through the Student Disability Advice Team or the Student's Union Advice and Representation Centre, so that you are prepared should such circumstances arise.

For dealing with REs Extenuating Circumstances (or IMC), which affected either their assignment submission or resulted in the assignment failure (assignment mark is below 50% pass), **the following procedure** is established to ensure that judgments as consistent and robust as possible, in year and year-on-year, as well as to provide REs with necessary guidance and support in difficult circumstances.

- The Systems centre **Special Circumstances Committee (SCC)** is formed and consists:

(a) MRes in Systems Programme Director
(b) MRes in Systems Deputy programme director
(c) Programme Coordinator;

- The committee considers the cases of REs, whose performance in any summative assessment may have been affected by illness or other extenuating circumstances (IMC).
- SCC follows University regulations on Data protection and ensures that all personal and sensitive information provided by an RE in support of their IMC case, will be treated in confidence at all times!;
- If you are having difficulty to follow the course due to IMC, such as illness, bereavement etc, and this affects your overall performance**, please do not delay and communicate to the SCC.**
- Dealing with Failed Unit (mark is <50%): Based on information and supporting evidence, provided by RE, the SCC will assess the situation and prepare anonymous case report to the Faculty Exam board. This report includes a summary of overall performance on the programme, including research component and other evidence of successful progression.
- The Faculty Exam board will make a decision, which could be either **Pass Not Withstanding** or **Re-submit**. This decision will be made in accordance with the CoP for Taught PG Programmes.

Further information:
Students' Union http://www.ubu.org.uk/support
ACCESS unit for Deaf and Disabled Students
http://www.bristol.ac.uk/accessunit/currentstudents/
Code of Practice for Research Degrees
http://www.bristol.ac.uk/esu/pg/cop-research-degrees.html
Faculty of Engineering Research Postgraduate Handbook
https://www.bris.ac.uk/engineering/currentstudents/handbooks/pgrhandbook/index.html
Faculty of Engineering Taught Postgraduate Handbook
https://www.bris.ac.uk/engineering/currentstudents/handbooks/pgthandbook/index.html

6 Progress Review Process

6.1 Planning , Time management and Ownership

An important part of MRes project work is planning, and the monitoring of progress with respect to these plans. REs plans should project at least one year ahead, including deliverables, milestones, and plans for dissemination. These plans should be agreed with both your academic and industrial supervisors and recorded in the Annual Progress Review form.

It is an expectation, that every Research Engineer is responsible for:

- Core Units attendance,
- timely assignment submission,
- participation in the conferences and other collaborative activities,
- personal development through available transferable skills training programme
- satisfactory progress with the research ,
- regular contact with Supervisors

A sufficient planning and time management should be dealt with to meet these responsibilities.

6.2 1st Year Progress Report

To ensure achievement of the ongoing learning and research objectives, REs are required to participate in a formal progress monitoring. Informal progress monitoring should be addressed through a regular communication with Supervisors, whereas formal progress review takes place at the end of the 1st Year of the programme – mid point progress review.

A Research Engineer is required to submit a 1st year report, which will include:

- A developed business case for the MRes research project
- A Literature review – an overview of the main concepts/conclusions derived from a critical evaluation and analysis of papers read and concepts encountered, relevant to a chosen research topic
- A detailed research plan for the final year
- A summary of achieved results of the 1st year through taught Units and any other research activities (conferences, publications) undertaken.

This report will be submitted to an academic supervisor, and a formative feedback will be provided by the supervisor to ensure that a sufficient progress during Year 1 is made towards the final MRes dissertation at the end of the 2nd year.

Following on report submission, REs must take responsibility for arranging a review meeting with all Supervisors, to discuss a detailed feedback and research planning for the final year. The 1st Year Annual Review form should be completed at this review meeting, all commets are recorded in the Annual Review Form, signed by all supervisors and submitted to the programme Coordinator. The MRes progression process is shown in the Annex 4.

7 ADMINISTRATIVE DETAILS

7.1 Registration

The RE must register as a taught postgraduate student.

Registration determines both the final award that the RE will receive and University's regulations and procedures the RE must comply with during the course of their studies.

Complaints and Appeals
Complaints/appeals at unit and programme level will be dealt with according to the University's procedures.
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Laptop Computers
The RE may be required to use a laptop computer whilst attending the core units. Some units may require the use of particular software packages, e.g. MATLAB.

Library and network arrangements for REs
The RE will have library access and campus network access. REs will automatically receive access to the University's network, electronic library resources and borrowing libraries.

7.2 Induction Programme

At the start of the first year of the programme, REs will be expected to attend an "Induction Course" to which Industrial Supervisors may also be invited.

7.3 RE Entitlements and Responsibilities

REs are part-time students of Bristol and will be made aware of their entitlements and responsibilities by the University once they have accepted their place. This information will also form part of the RE's initial meeting with their principal Academic Supervisor. REs should refer to the Code of Practice of the University

A summary of roles and responsibilities of the RE and other members of the programme is provided at **Annex 5**.

Support arrangements
Academic Supervisors are the first port of call for REs' non-academic queries and concerns. However, REs are advised to discuss administrative matters with the Systems Centre staff in the first instance.

Other sources of advice and information at Bristol
The Access Centre for deaf and disabled students:
http://www.bris.ac.uk/depts/AccessUnit/
The *Student Help* site which provides advice for all students on all aspects of University life including study, personal and practical problems: *http://www.bris.ac.uk/studenthelp/*

RE representation

Student representatives at Bristol attend the Faculty Board, various Faculty committees and Senate. REs are eligible to stand for election as student representatives. Please contact your departmental office for details of your student representative.

7.4 Problem Resolution

If problems arise with your project work during your time as a Research Engineer, you should normally contact your academic and industrial supervisors in the first instance. However, if resolution is not possible by this route, you should contact the Centre Team: Centre/Programme Director & Deputy, IDC Coordinator/administrator.

Problems related to coursework should be referred directly to the Unit Director, and copied to the Administrator/Coordinator.

REs representatives regularly meet with the Centre Support team (Manager, Coordinator and administrators). All comments from REs is recorded and taken to the IDC management meeting. Subsequently, resolutions of the IDC management meeting are communicated back to the reps, and REs reps will produce a News letter, to inform all cohorts about actions taken and issues addressed. This news letter is distributed via mailing list and published on the website.

If you wish to raise any issues at a management-level meeting, please feedback to the nominated REs rep.

7.5 Absence Due to Ill-Health

For absence due to ill health, REs should inform the Systems Centre staff. For that a record may be kept for use by the Board of Examiners. This should be accompanied by the appropriate supporting evidence (e.g. note from the RE's doctor).

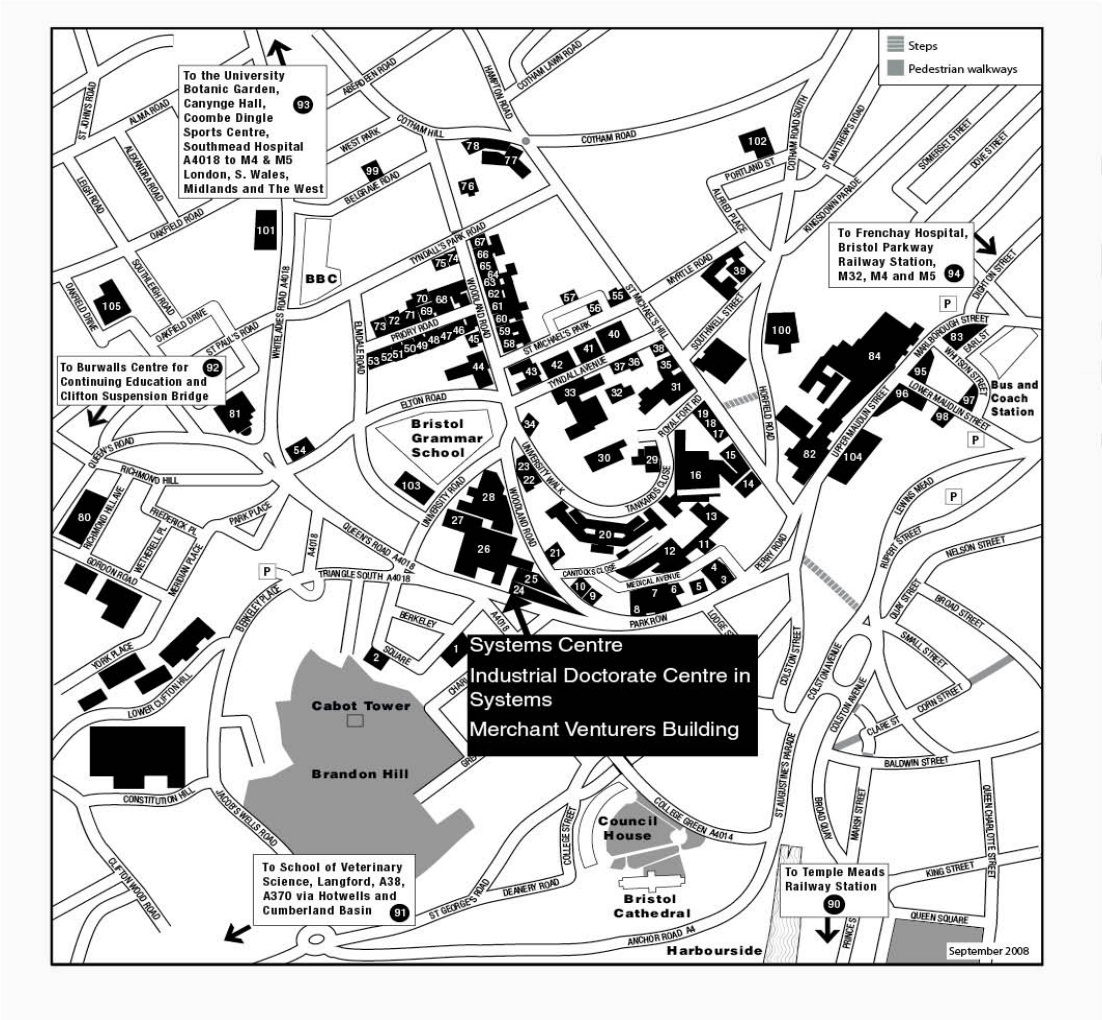
7.6 Facilities

The Systems Centre is based in the Merchant Venturers Building (formerly the KES Suite) where a dedicated REs Office is available. Any REs who are visiting the University of Bristol are very welcome to drop in, and to use the flexible accommodation as needed, either for occasional study or social gatherings, to practise presentations, hold informal discussions, debating sessions or for self-run study days.

ANNEXES

Annex 1 – University of Bristol Precinct Map

For further details and directions, please view the University of Bristol website:
http://www.bristol.ac.uk/university/maps/



Annex 2 - Core Units

Please note that core unit content may change to suit the requirements of Industry, in response to feedback from REs and to reflect developments in the fields of each of the units.

Problem Structuring and Research Methods

Unit Director	Dr Mike Yearworth
Unit Venue	University of Bristol, Systems Centre
Aims	This unit will introduce students to the basic principles of problem structuring and research methods and their application in research projects across the pure, applied and social sciences to enable engineering systems research at Doctoral Level.
Description	The unit will cover the basic research assumptions, paradigms and philosophical positions underlying different traditions in research, review approaches to exploration and definition of problem fields, consider different research design strategies and outline approaches for conducting the literature review. These will be positioned within an approach to systemic problem structuring methods so that there is a clear understanding of the relationship between a systems approach and research methods typical of business and management. Techniques for gathering and rigorously analysing data of both quantitative and qualitative types and reporting of research results in peer reviewed publications will also be covered. Emphasis will be placed on the need to combine different philosophical research positions and quantitative and qualitative approaches when addressing real-world problems in engineering systems which bridge traditional research disciplines. This will enable students to successfully design, conduct and supervise various types of research in an ethical manner and give them a broad understanding of the purpose and application of problem structuring and research methods. This unit aims to give students in depth knowledge, understanding and skills in generic research methods and research design strategies. In terms of learning styles and generic skills, the unit also introduces students to the concept of reflective learning logs and gives guidance on the use of such logs and reflective writing.

Teaching	The teaching and learning strategy is based on flexible and student-centred learning approaches. It will involve a mixture of lectures, case studies, group work, plenary discussions, and a workshop on research design. The principles of writing reflective logs will also be covered. Through this approach it is aimed to provide an enjoyable learning experience consistent with the principles of adult education with ample space for exploring, questioning, and debating issues of particular interest and for exercising rational argumentation. A Visiting Lecturer will be engaged for part of the delivery of the unit covering qualitative research methods. The unit will also draw on support from other members of the Systems Research Group including Lecturers, Research Assistants and Research Associates to help facilitate the delivery of the day-long research design workshop.
Assessment	The end of unit assignment is a reflective log in which students are required to reflect on their new learning in the unit, map this against the requirements of their nominated EngD research project and design an action plan to progress their research methodology planning (indicative word count of 5,000 words). The reflective log is structured precisely to align with the learning outcomes stated here; i.e. we stipulate this structure. The knowledge and skills identified in the learning outcomes are demonstrated in the assignment by the three aspects which the learning log addresses for each outcome - a) description of learning session associated with the outcome, b) reflection of new knowledge skills against previous experience/demands of their project, and c) action planning in relation to applying the learning outcome to their project.
Learning outcomes	This unit provides opportunities for students to develop and demonstrate in depth knowledge, understanding and skills in research in the following areas: • Exploration of wicked and messy problems • Systemic problem structuring methods • Basic research paradigms and philosophical positions underlying different traditions in research • Integrating research methods into systemic problem structuring methods • Articulating research questions and hypotheses • Scoping and conducting a literature review • Critical reading of primary research literature • Research design strategies and combined qualitative/quantitative approaches • Justification of research design including considerations of reliability, validity and generalisability • Ethical considerations in research • Conducting rigorous qualitative and quantitative data collection and analysis • Presentation and reporting of findings in peer-reviewed publication • Reflective learning skills

Systems Engineering

Unit Director	Dr Theo Tryfonas
Unit Venue	University of Bristol, Systems Centre
Aims	This unit is the first taught element in the EngD in Systems and introduces the student to the basics of traditional “hard” systems engineering with a product based emphasis.
Description	Wider aspects are introduced to highlight that the material is a starting point rather than a complete coverage of Systems Engineering. Students will be of high graduate standard so that although the topic is new to them they will be learning at Masters level.
Teaching	Lectures, group workshops, practical sessions
Assessment	In-class test, administered on-line via the Virtual Learning Environment 10%) Coursework, in the form of an individual essay related to some aspect of the unit"s material and activities (90%, word count ~ 2500)
Learning Outcomes	To provide an introduction to Systems Engineering and relate it to the student"s industrial background On successful completion of the unit the student will: • possess an elementary and mostly qualitative knowledge of systems engineering theory, modelling techniques and industrial conventions and practice • have an increased practical understanding and some experience in implementing the requirements generation and other key lifecycle processes • have an awareness of and ability to evaluate a wider range of systems engineering concepts beyond the scope of the unit material • have developed further skills in writing technical documentation.

Mathematics for Systems

Unit Director	Professor Eddie Wilson
Unit Venue	University of Bristol, Systems Centre
Aims	This unit will acquaint students with modern applied mathematics topics, which build upon and span beyond material traditionally taught to undergraduate engineers. The style of the course will be one of raising broad awareness of the mathematical tools that are available, rather than traditional didactic teaching in narrow topics.
Description	This unit will give an introduction to some topics in modern applied mathematics, which are applicable to systems engineering methods. The teaching will be delivered in one week, with different topics each day. Typical titles of the topics are: Complex Networks; Information from Data; Optimisation and Linear Programming; Handling Uncertainty; Nonlinear Dynamics.
Teaching	One week full-time course. Small group interactive lectures plus break-out into discussion groups. Break-out into small computer demo classes. Follow-on support by email contact with postgrads / postdocs.
Assessment	• **Each of the unit's topics will have a short worksheet to be completed within two weeks after the teaching (30% of the overall assessment).** • **Each of the unit's topics will also have a suggested list of ideas/applications for future study.** • **Each student will pick one idea/application, investigate it more fully and provide a written report (70% of the overall assessment, the assignment length will be max of 10 pages)**
Learning Outcomes	At the end of this course, students will: - be comfortable with the Matlab interface and basic programming constructs; and be able to apply Matlab to solve basic problems in simulation and in data analysis. - be able to identify the hallmarks of real-world nonlinear behaviour, and be able to re-count and apply some of the basic mathematical terminology and results (e.g. bifurcations) - be able to phrase optimal design problems in mathematical language and be able to identify which of several broad families they apply to, and hence make an informed choice about the solution method; this section will also include use of parameter continuation techniques. - understand the difference between data and knowledge and be able to list some standard techniques for extracting the latter from the former, and be able to implement these techniques in Matlab. - be able to list real-world case studies in which there are emergent phenomena from many simple interacting subsystems, and be able to investigate this emergence by using simple simulation techniques. - have an appreciation of the manifold possibilities in the application of modern applied mathematics to real-world problems.

COMPLEX SYSTEMS DESIGN

Unit Director	Professor Chris McMahon
Unit Venue	University of Bristol, Systems Centre
Aims	The technologies of the modern world have led to a proliferation of complex systems that serve all manner of societal needs, including transportation, energy supply, healthcare, industrial production and communications. The design and development of such systems and of the components and sub-systems that make them up are enormously challenging, and require that knowledge and expertise from a number of perspectives be brought together in an integrated manner to consider a wide range of technical, social and environmental issues. The aim of this unit is to introduce design thinking, theories, methods and tools in the context of such complex systems.
Description	The unit will begin with an exploration of the nature of design and of design thinking, drawing on recent research into design theory and methodology. This will be followed by an exploration of the nature of complex systems and of the design challenges that they pose. From these foundations the course will develop four strands, all illustrated by engineering examples: 1. Design for the Systems Lifecycle. This strand will introduce the stages of the systems life cycle and will describe and illustrate life cycle models and techniques for the development and evaluation of life cycle properties and impacts. 2. Systems Architecture, Modelling and Analysis. This strand will build on the material presented in the Introduction to Systems module to consider the structure, arrangements or configuration of system elements and their internal relationships necessary to satisfy customer requirements and technical constraints. It will present methods for system analysis, modelling and simulation, for interface design and for system decomposition and structuring in the context of design. 3. Managing Complex Systems Design. Management of the design of complex systems is extraordinarily demanding. In this strand students will learn about project management approaches for systems design, including project modelling techniques, planning and scheduling methods for project management, modelling and managing risk and uncertainty in systems design, project monitoring and scheduling and cultural and man-management issues. 4. Human Behaviour in Design. Human behaviour considerations pervade systems design, from the creative behaviour of designers, through the team-working considerations of the distributed and often multi-cultural design teams to the behaviour including the emotional response of users and other stakeholders. This strand will explore all of these issues. It will link to strand 3 through consideration of socio-technical aspects of risk including risk perception.
Teaching	Interactive lectures (engineers relate their own experience in dealing with issues that arise), seminars from outside experts, and workshops and team exercises.

Assessment	• Pre-module reading and data collection on product/systems design context in the RE's company (20%, word count = ~1000) • An assignment done in groups of REs to develop comparative studies of systems design issues and approaches in different engineering contexts, exploring in particular the issues presented and discussed in the unit. This will be assessed by means of a presentation of initial findings in class (30%) together with a group report (2000 words each) (50%) For both assessments the RE is expected to take a critical and well-referenced approach at a level expected in a doctoral level thesis.
Learning outcomes	On successful completion of the unit the student will be able to: • Outline the nature of design thinking as applied to complex systems design • Describe the phases of the systems life cycle • Outline and understand the application of techniques for system architecture design. • Apply original thought to the development of practical solutions for products, systems, components or processes • Describe and understand the application of techniques for systems modelling and simulation in a design context. • Understand, critically evaluate and apply concepts in the management of complex systems design, and describe and apply management techniques that can be applied in that context. • Describe and apply techniques for modelling and managing risk and uncertainty in systems design, including the ability to assess the limitations of particular approaches. • Make general evaluations of risks through some understanding of the basis of such risks, including an understand of socio-technical issues in design risk management. Describe human behaviour issues in design, both in design activities in the use of the designed artefact.

Socio Technical Systems

Unit Director	Dr Mike Yearworth
Unit Venue	University of Bristol, Systems Centre
Aims	This unit is at the heart of the Systems EngD and is integrated with Problem Structuring and Research Methods (CENGM0006). It develops understanding and awareness and deals with specific tools in the softer aspects of systems, building on the use of methods such as such as grounded theory, ethnography, and action research together with qualitative data gathering and analysis approaches that have been introduced in Problem Structuring and Research Methods. It builds further on, and deepens and widens, the philosophical underpinnings of systems and systems thinking research introduced in Problem Structuring and Research Methods. The unit takes as its primary assumption that social and technical systems are interacting and interdependent and cannot be analysed or understood reductively in isolation, hence leading to a working definition of socio-technical systems.
Description	The unit introduces the use of specific systems modelling approaches that can be used as Problem Structuring Methods (PSMs) including i) Hierarchical Process Modelling (HPM) (e.g. using the PeriMeta software tool), ii) Causal Loop Diagramming (CLD) and System Dynamics (SD) Modelling, and iii) Agent Based Modelling (ABM). These systems modelling approaches each have strengths and weaknesses and these are addressed by taking a philosophical approach to understanding the value of each method with respect to how they provide better understanding of risk, uncertainty, dynamic and emergent behaviour in complex socio-technical systems. The unit also enables Research Engineers (REs) to appreciate the value of multimethodology, argumentation and Issue Based Information Systems (IBIS), and group model building. Socio-Technical Systems presents new and in-depth material to soft systems that allows REs to reconsider/update/enhance and bring additional rigour to soft systems aspects of the initial research plan developed in Problem Structuring and Research Methods by: 1. Developing a “softer” systems perspective of complex engineering problems and in particular a better appreciation that problems are constructs of an individual’s mind and therefore do not exist independently of human thought. Also that these constructs are defined by an individual’s “world view” and that different but equally valid interpretations of the real world can exist among individuals 2. Appreciating that the problem field is invariably messy – many potentially related problems and sub-problems can interact in any given system and that solutions to problems are also intellectual constructs and that no problem exists in isolation 3. Understanding that improvements and beneficial interventions in any system problem are most likely to come through sharing of perceptions, persuasion and debate, and the importance of taking an ethical approach at all times 4. Appreciating the range of systems interventions/problem structuring methods in the systems literature and where they can be applied in engineering systems, and understand their philosophical underpinnings in functionalist and interpretive stances and the implications of plural and coercive contexts
Teaching	Interactive lectures (engineers relate their own experience in dealing with issues that arise), seminars from outside experts, and workshops and team exercises.

Assessment	An assignment based on, and with reference to, the problem structuring and systems modelling approaches presented and debated in Socio-Technical Systems that discusses how they can be selected and applied to the Research Engineer's EngD project. The assessment is expected to contribute to the development of research planning and reconsider soft systems aspects in the light of material discussed in the unit. The RE will be expected to take a critical and well-referenced approach at a level expected in a doctoral level dissertation. (100%, indicative word count ~3000 words).
Learning outcomes	On successful completion of the unit the Research Engineer will be able to: • Describe and apply a systems approach in a socio-technical systems context • Recognise that dealing with messy problems requires working with a plurality of world views • Describe and map out organisational processes and use systemic problem structuring methods • Build relevant causal loop diagrams, system dynamics models, hierarchical process models, and agent based models • Begin to intervene in a given systems context • Identify the ethical dilemmas encountered in business and use problem structuring methods in an appropriate and ethical manner

Integrating Engineering and Management Systems

Unit Director	Prof Patrick Godfrey
Unit Venue	University of Bristol, Systems Centre
Aims	This unit is the final mandatory module in support of the Research Engineers EngD research project. It takes the form of a “master class in two sessions” to address key challenges in systems engineering that have emerged from the first 18 months of their EngD research work. Each RE will identify a real challenge and submit it at start of the module. The RE will facilitate a team of about 5 peers (Other EngD REs) to identify and assess strategies to meet the challenge. The RE will then implement the strategy whilst maintaining a reflective diary and then produce a conference quality paper on implementation and learning achieved. This will be presented to and be peer reviewed by the rest of the EngD cohort and supervisors and after completion logged as part of the body of knowledge accumulated by the Systems Centre.
Description	On successful completion of the module the student will have demonstrated that they can plan and deliver a systems thinking approach to solving a practical systems problem and used the process to add to the body of knowledge in the subject. They will learn how to produce a conference quality paper which they will be encouraged to publish externally. They will also learn from peer review of
Teaching	The module will be taught as a “master class” with a Tutor acting as coach in breakout groups of about 5 people with plenary feed back of learning and performance measurement.
Assessment	Assessment will be of the following submitted on completion of the work: their colleagues approaches and results. 1. Statement of the problem and strategy for solution or resolution. (10%) 2. Reflective diary - no more than 5 pages A4 (10%) 3. Conference quality paper presented and submitted to add to the body of knowledge of solving systems engineering problems (80%, 3-6 pages).
Learning outcomes	On completion of the module the RE will have: 1. Demonstrated they know how to formulate and present a systems engineering problem 2. Facilitated a team approach to problem solving and strategy formation 3. Understood the value of peer review as a reviewer and reviewee 4. Used a reflective diary to establish learning during delivery of the problem solution or resolution 5. Produced and present a conference quality paper that adds to the body of knowledge of systems engineering

Annex 3 – Programme Specification

There are 2 components to this programme:

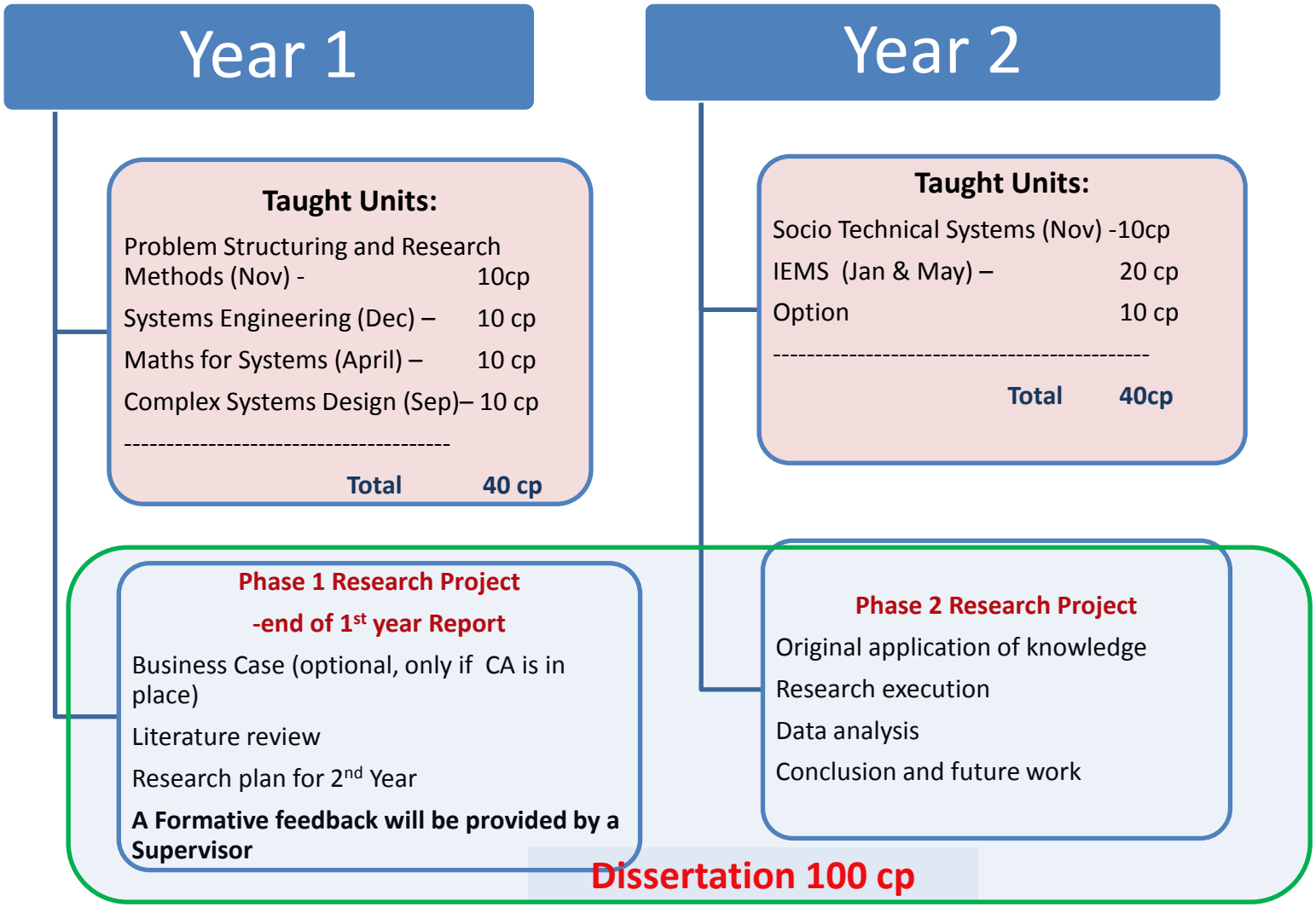
(a) a taught component at Masters level, shown below as Stages 1 and 2, **is delivered concurrently with the industry based research project to ensure that the reflective learning in Systems methodologies and tools, gained through taught Units, is applied to the Company's based research.**

This mode of MRes programme delivery is specifically chosen to address the research objectives of MRes students, who are Employees in their companies and part time PG students.

(b) a dissertation component at Masters level, shown below as Stage 3.

	Level	**Unit code**	**Unit title**	**Credit points**	**Mandatory (M) Optional (O)** or **Open**	**Progression/award requirements**
	M	CENGM0015	Problem Structuring and Research Methods	10	M	*Unit Pass mark: 50%*
	M	CENGM0016	Systems Engineering	10	M	
	M	EMATM0005	Mathematics for Systems	10	M	
	M	Various	Bristol Optional Unit 1	10	O	
	M	CENGM0013	Complex Systems Design	10	M	*Unit Pass mark: 50%*
	M	CENGM0014	Socio Technical Systems	10	M	
	M	CENGM0011	IEMS	20	M	*Exit award at Certificate 60 credits*
		Total taught component		**80**		
	M	CENGM9200	Research Dissertation	100		*Minimum credit points for progress to next stage of programme: 20* *Minimum of 50% overall to progress* *Distinction:* - *65% - 70% for taught component* - *70% for dissertation* *70% overall*
		Total MRes in Systems		**180**		

Annex 4 -MRes in Systems Progression Process



Annex 5 – Summary of roles and responsibilities

Industrial Doctorate Centre in Systems - Main responsibilities of the Research Engineer, the Academic and Industrial Supervisors and the Systems Centre Staff

Research Engineer(research student)	Academic Supervisor 1- Principal	Industrial Supervisor	Programme Coordinator)	Programme Director	Systems Centre manager	Systems Centre Director
To register each year with the relevant University.	To provide expert advice and guidance to the RE in the project domain area.	To provide the main point of contact with the Collaborating Company.	To provide the first point of contact for all queries.	To approve offers to candidates.	Overall responsible for all operations (academic and administrative)	To lead and manage the joint Centre.
To comply with all relevant regulations at the University where they are registered and in the company workplace.	To meet regularly with the RE – at least once a month.	To progress the project within the company and ensure the project remains pertinent to the company's needs.	To provide support for all the academic processes, including admissions, teaching and assessment.	To monitor the overall programme in terms of academic content, coherence and quality.	Ensuring best practice: Duty of Care to all REs, adequate spending of public funds, all processes are fit-for-purpose, and continuous improvement	To liaise between the Universities of Bristol and Bath and to report to them as required.
To take prime responsibility for the progress of their research.	To liaise with the other supervisors and to meet them and the student at least once every 3 months.	To provide technical and/or managerial advice on the industrial problem being addressed through the Research Project.	To provide administrative support for the Systems Centre.	To deliver the overall programme and monitor communication and feedback between staff and students.	Liaising with other IDC/DTC Centres, on strategic issues,	To liaise with all the industrial partners and to report to the Strategic Advisory Board.
To maintain effective working relationships with their supervisory team.	To make sure the student is aware of the academic standards required for the award of an EngD.	To ensure that the RE has the opportunity to apply the knowledge gained from the taught EngD units.	To produce publicity and update all programme information.	To oversee all assessment processes.	Managing Bristol-Bath relationship,	To report to EPSRC as required.
To meet regularly with their supervisory team and to keep appropriate records of these meetings.	To comment on written work and to provide prompt feedback.	To provide professional and career development advice to the RE.	Responsible for REs academic progress monitoring	To review the overall progress at the end of each academic year and advise on development.	Preparing reports/reviews for EPSRC	
To complete taught units as required and to submit work for assessment in a timely fashion.	To offer guidance on preparing the dissertation, up to final draft stage.	To liaise with the academic supervisors and to meet with them and the RE at least once every 3 months.; to provide coherent supervision in line with doctorate degree training and research	Setting up and maintaining databases, e.g. students, academics and industry contacts; REs portfolios overviews		Overall responsibility for client relations, i.e. companies, students Tracking & progressing collaborations from start to signing agreements	
To keep appropriate records of their research and their personal development(Transferable and personal skill s training)	To advise the RE on other sources of support at the University.					