

Programme Specification for Postgraduate Programme Leading to: MSc Lightweight Structures and Impact Engineering MSc Lightweight Structures and Impact Engineering with Internship MSc Lightweight Structures and Impact Engineering with Placement

Applicable for all postgraduate students starting in 2021.

Version No.	Date	Notes – QUALITY ASSURANCE USE ONLY	QA
2021-22 v1	25 November 2020	Senate approved this new programme, which will be taught off-campus at National Structural Integrity Research Centre (NSIRC) Cambridge.	JP
2021-22 v2	22 February 2021	Route code added - 1JA8PLISTIE	JP
2021-22 v2.1	8 March 2021	HECoS code weighting confirmed as 100190 - Mechanical Engineering – 34%; 100115 - Aerospace Engineering – 33%; 100201 - Automotive Engineering – 33%.	JP
2021-22 v3	25 May 2021	Block codes added.	JP

Postgraduate Taught Programme	
1. Awarding institution	Brunel University London
2. Teaching institution(s)	Brunel University London
3. Home College/Department/Division	College of Engineering, Design and Physical Sciences Department of Mechanical and Aerospace Engineering
4. Contributing College/Department/Division/ Associated Institution	Department of Mechanical and Aerospace Engineering Brunel Centre for Advanced Solidification Technology (BCAST) Taught off-campus at National Structural Integrity Research Centre (NSIRC) Cambridge.
5. Programme accredited by	
6. Final award(s) and FHEQ Level of Award	MSc in Lightweight Structures and Impact Engineering (FHEQ 7) MSc in Lightweight Structures and Impact Engineering with Internship (FHEQ 7) MSc in Lightweight Structures and Impact Engineering with Placement (FHEQ 7)
7. Programme title	Lightweight Structures and Impact Engineering
8. Programme type (single honours/joint)	N/A
9. Normal length of programme (in months) for each mode of study	MSc: Full-time (12 months), Part-time (24 months) MSc with Internship: Full-time (15 months) MSc with Placement: Full-time (24 months)
10. Maximum period of registration for each mode of study	Normal or standard duration, plus two years
11. Variation(s) to September start	None
12. Modes of study	Full-Time / Part Time
13. Modes of delivery	Block Mode

14. Intermediate awards and titles and FHEQ Level of Award	PG Diploma in Lightweight Structures and Impact Engineering (FHEQ 7) PG Certificate Lightweight Structures and Impact Engineering (FHEQ 7)
15. UCAS Code	N/A
16. HECoS Code	100190 – 34% 100115 – 33% 100201 – 33%
17. Route Code	1JA8PLISTIE
18. Relevant subject benchmark statements and other external and internal reference points used to inform programme design	UK Quality Code for Higher Education QAA Subject Benchmark Statement (Engineering) Brunel 2030 Brunel Placement Learning Policy, as published under the 'Placements' section of the Managing Higher Education Provision with Others page. Engineering Council, UK-SPEC document "Chartered Engineer and Incorporated Engineer Standard" Engineering Council, Accreditation of Higher Education Programmes (AHEP)
19. Admission Requirements	Details of PGT entry requirements are provided on the University's and College website. Levels of English for non-native speakers are outlined on Brunel International's language requirements pages.
20. Other relevant information (e.g. study abroad, additional information on placements)	Internships and Placements are undertaken after completion of the MSc programme (taught and dissertation components) and provide significant flexibility for applicants who can attain a Master's degree, with or without working in an industrial setting. The responsibility for finding an internship / placement lies with the student, as the University cannot guarantee any form of work experience, just the opportunity to undertake it if available. There will be supervision, guidance and support for students embarking on the placement. Students who cannot secure a placement by the end of Term 2 after enrolling on the programme, will be reverted to the full-time programme.
21. Programme regulations not specified in Senate Regulation 3. Any departure from regulations specified in Senate Regulation 3 must be stated here and approved by Senate.	N/A
22. Further information about the programme is available from the College website.	Link to programme information on the College website

23. EDUCATIONAL AIMS OF THE PROGRAMME

Advanced structures using novel, lightweight materials are one of the key enabling technologies for a range of sectors. In reducing inherent structural weight, it is essential not to compromise safety, with issues including structural integrity and designing for crashworthiness becoming key design drivers. For example,

- In the transportation sector, light-weighting is essential to reduce inherent structural weight for manufacturers to meet national targets for carbon reduction.
- Design of portable consumer electronic devices, including impact and shock protection.
- Maximising payload in space applications, where the underlying structure becomes the key design driver due to the high launch cost per kilogram.

- High performance cars, including F1, where composite and metallic materials are combined to ensure performance, commercial and competitive targets are met.

Designing lightweight structures to perform an intended function over its lifecycle, when subject to static and dynamic loading conditions encountered during normal operation and extreme loading conditions, requires expertise in a range of areas. This expertise primarily relates to the application of advanced numerical simulation to understanding non-linear material and structural response over different operating conditions, which may include large or rapid deformation, failure (static and transient), and high strain rate loading (inertial effects, wave propagation and shockwaves).

As new simulation and material technologies emerge, there is a continuing need for talented employees with a strong, applied understanding in structural analysis and testing, together with competent technical skills in non-linear numerical simulation (mesh and meshfree methods) that can be directly applied to industrial problems.

Key aims of the programme include:

- Develop a systematic understanding of non-linear structural response and material failure, informed by the current state of the art, to support lightweight structural design under a range of loading conditions, with particular emphasis on crashworthiness, structural integrity and impact related issues.
- Originality and application of this knowledge through understanding established analysis techniques and their limitations, applied to quasi-static, dynamic and extreme loading problems, which may include large or rapid deformation, where inertial effects, wave propagation and shockwaves dominate the response.
- To develop a firm grasp of the relationship of basic phenomena to real life engineering systems, and develop industrially relevant and marketable applied skills in structural analysis and design, using the latest industry standard advanced simulation codes (mesh based and mesh free).
- Develop initiative and personal responsibility in problem solving, project management (including compliance with safe operating practises and Health and Safety Procedures), decision-making and communication, by providing the infrastructure to successfully complete a fundamental or applied research project either independently, or through team-based learning.
- To supply high grade personnel to the structural integrity communities in UK, European and world industry, able to pursue careers in aerospace, automotive, offshore and defence sectors.
- Provide a clear pathway for continuing professional development, either through a doctoral training programme, or progression towards Chartered Engineer Status (CEng).

24. PROGRAMME AND INTERMEDIATE LEARNING OUTCOMES

The programme provides opportunities for students to develop and demonstrate knowledge and understanding (K) cognitive (thinking) skills (C) and other skills and attributes (S) in the following areas:

Masters FHEQ Level 7	Category (K = knowledge and understanding, C = cognitive (thinking) skills, S = other skills and attributes)	Learning Outcome	Masters Award Only	Associated Assessment Blocks Code(s)	Associated Study Blocks Code(s)	Associated Modular Blocks Code(s)
Masters and FHEQ level 7						
1.	K, C [SM7m]	A comprehensive synthesis and understanding of established principles, concepts and theories underpinning the design and analysis of lightweight structures	ME5612 Dissertation With optional internship: ME5647 Internship	ME5801 Applied Continuum Mechanics and FEA	ME55704 Applied Continuum Mechanics 1: Fundamentals ME5705 Applied Continuum Mechanics 2: FEA	ME5600 Fracture Mechanics and Fatigue Analysis ME5601 Metallurgy and Materials ME5644 Composite Material Structures

			With optional Placement: ME5648 Placement		ME5703 Structural Mechanics Fundamentals	ME5646 Automotive Integral Vehicle Structures ME5645 Thin Walled Structures
2.	K, C [SM7m]	Examine and evaluate complex issues and phenomena associated with the analysis of structures under extreme loading.		ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	
3.	K, C [SM8m]	Investigate and appraise the state of the art in numerical, experimental and material characterisation techniques and their application to structural design	ME5612 Dissertation	ME5801 Applied Continuum Mechanics and FEA ME5800 Group Project	ME5704 Applied Continuum Mechanics 1: Fundamentals ME5705 Applied Continuum Mechanics 2: FEA ME5707 Impact and Crashworthiness ME5706 Advanced Transient Simulation Methods	ME5601 Metallurgy and Materials ME5644 Composite Material Structures
4.	K, C [SM9m]	Through critical evaluation of established analysis techniques and their limitations, employ appropriate concepts to support the solution of engineering problems	ME5612 Dissertation With optional internship: ME5647 Internship	ME5801 Applied Continuum Mechanics and FEA ME5800 Group Project	ME5703 Structural Mechanics Fundamentals ME5704 Applied Continuum Mechanics 1: Fundamentals ME5705 Applied Continuum	ME5600 Fracture Mechanics and Fatigue Analysis ME5601 Metallurgy and Materials ME5646 Automotive Integral Vehicle Structures

			With optional Placement: ME5648 Placement		Mechanics 2: FEA ME5706 Advanced Transient Simulation Methods ME5XXX Impact and Crashworthiness	ME5645 Thin-Walled Structures
5.	K, C, S [EA6m]	Demonstrate originality, application of knowledge and initiative in complex problem solving, demonstrated through critical analysis and interpretation of results.	ME5612 Dissertation With optional internship: ME5647 Internship With optional Placement: ME5648 Placement	ME5801 Applied Continuum Mechanics and FEA ME5800 Group Project	ME5704 Applied Continuum Mechanics 1: Fundamentals ME5705 Applied Continuum Mechanics 2: FEA ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	ME5600 Fracture Mechanics and Fatigue Analysis ME5601 Metallurgy and Materials ME5644 Composite Material Structures ME5646 Automotive Integral Vehicle Structures ME5645 Thin-Walled Structures
6.	K, C [EA5m]	Critically relate fundamental principles, concepts and theories to interpret and evaluate the latest research in an engineering structures related area	ME5612 Dissertation			ME5601 Metallurgy and Materials
7.	C [EA7m]	Assemble and critically analyse primary, secondary and incomplete data to support the engineering approach developed to solve an unfamiliar problem	ME5612 Dissertation	ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	ME5600 Fracture Mechanics and Fatigue Analysis ME5644 Composite Material Structures

8.	C, S [D9m]	Identify and apply relevant statistical, analytical, numerical or testing techniques to minimise uncertainties in information and quantify its effect on the design	ME5612 Dissertation	ME5801 Applied Continuum Mechanics and FEA ME5800 Group Project	ME5704 Applied Continuum Mechanics 1: Fundamentals ME5705 Applied Continuum Mechanics 2: FEA ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	
9.	K, C [D10m]	Appraise and employ current design, industry standards and certification practices to support the engineering design process	ME5612 Dissertation	ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	ME5646 Automotive Integral Vehicle Structures
10.	K, C, S [D11m]	Through analysis, simulation or experimentally led design, propose, develop and validate lightweight structural engineering concepts (and impact protection systems where appropriate) to address an engineering problem	ME5612 Dissertation			
11.	C [EL8m]	Consider and relate the strategic context and importance of professional conduct in engineering.	ME5612 Dissertation With optional internship: ME5647 Internship	ME5801 Applied Continuum Mechanics and FEA ME5800 Group Project	ME5704 Applied Continuum Mechanics 1: Fundamentals ME5705 Applied Continuum Mechanics 2: FEA ME5706 Advanced Transient	ME5601 Metallurgy and Materials

			With optional Placement: ME5648 Placement		Simulation Methods ME5707 Impact and Crashworthiness	
12.	C [EL9m]	Consider the commercial and social contexts and its influence on the design process	ME5612 Dissertation With optional internship: ME5647 Internship With optional Placement: ME5648 Placement	ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	
13.	C, S [EL10m]	Systematically evaluate and employ appropriate techniques to manage time and resources to achieve required objectives	ME5612 Dissertation With optional Placement: ME5648 Placement			
14.	K, C [EL11m]	Consider the importance and influence of sustainable / responsible use of resources within engineering activities	With optional Placement: ME5648 Placement			ME5601 Metallurgy and Materials
15.	K, C [EL12m]	Critically evaluate the regulatory requirements and their importance to the design and analysis of lightweight engineering structures	ME5612 Dissertation With optional Placement: ME5648 Placement	ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	
16.	C, S [EL13m]	Categorise, evaluate and manage risk to a project, including health & safety, environmental or commercial (where relevant).	ME5612 Dissertation			

			With optional internship: ME5647 Internship			
			With optional Placement: ME5648 Placement			
17.	K, C [P12m]	Investigate material performance, surface engineering techniques and failure to evaluate the latest capabilities and limitations in advanced simulation codes / analysis approach	ME5612 Dissertation	ME5801 Applied Continuum Mechanics and FEA ME5800 Group Project	ME5704 Applied Continuum Mechanics 1: Fundamentals ME5705 Applied Continuum Mechanics 2: FEA ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	ME5600 Fracture Mechanics and Fatigue Analysis ME5601 Metallurgy and Materials ME5644 Composite Material Structures ME5645 Thin-Walled Structures
18.	S [P9m]	Develop an independent learning ability to investigate and evaluate the state of knowledge and latest research in a specific subject area	ME5612 Dissertation	ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	ME5601 Metallurgy and Materials ME5644 Composite Material Structures
19.	K, C [P10m]	Systematically evaluate and justify appropriate engineering techniques, taking into account commercial and industrial constraints	ME5612 Dissertation With optional internship:	ME5801 Applied Continuum Mechanics and FEA	ME5705 Applied Continuum Mechanics 2: FEA	

			ME5647 Internship			
			With optional Placement: ME5648 Placement			
20.	S [P11m]	Determine, manage and prioritise time and resources to achieve required objectives on an unfamiliar problem, either individually, or as part of collaborating and /or leading a team		ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthine ss	
21.	S [G1]	Develop effective problem solving through appropriate selection of IT, communication and presentation resources	ME5612 Dissertatio n With optional internship: ME5647 Internship With optional Placement: ME5648 Placement	ME5801 Applied Continuum Mechanics and FEA ME5800 Group Project	ME5704 Applied Continuum Mechanics 1: Fundamentals ME5705 Applied Continuum Mechanics 2: FEA ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthine ss	ME5600 Fracture Mechanics and Fatigue Analysis ME5601 Metallurgy and Materials ME5644 Composite Material Structures
22.	C, S [G2]	Develop an independent learning ability to support continued professional development, through performance evaluation and reflection	ME5612 Dissertatio n With optional internship: ME5647 Internship	ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthine ss	

			With optional Placement: ME5648 Placement			
23.	S [G3m]	Prioritise, plan and execute a substantial individual programme of work to successful completion, measured through regular monitoring and adaption where necessary	ME5612 Dissertation With optional internship: ME5647 Internship With optional Placement: ME5648 Placement	ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	
24.	S [G4]	Develop initiative and personal responsibility in problem solving, either independently or through team-based learning.	ME5612 Dissertation With optional internship: ME5647 Internship With optional Placement: ME5648 Placement	ME5800 Group Project	ME5706 Advanced Transient Simulation Methods ME5707 Impact and Crashworthiness	ME5600 Fracture Mechanics and Fatigue Analysis

Learning/teaching strategies and methods to enable learning outcomes to be achieved, including formative assessments

The aim of the programme is to provide students with effective training in the skills required for a master degree, and subsequently for the work place, and to empower them, with support, to take their own learning further, as they develop their critical analysis and problem-solving abilities.

Module design includes blending formal lectures, self-study questions, practical computational and lab-based workshops, self-study online videos, tutorials and group project work. The activities used are subject dependent and designed to place the student at the centre of the programme framework to encourage deeper learning. The programme will also be supplemented by invited external speakers from industry.

Delivered in a block mode typically across two weeks, timetabled self-study time is an important part of the delivery and learning process, which enables additional tutorial support to be scheduled.

A formative study block in structural mechanics and stress analysis has been designed to support those who may not have a direct mechanical engineering background. Assessment will be indirect through subsequent, more specialist modules that build on this material.

The programme will employ two 30 Credit assessment blocks, which allow a synoptic assessment of student learning on longer, more challenging problems. Group work also encourages personal responsibility of learning in order to achieve a collaborative goal, in addition to developing 'soft' skills, such as communication, planning and management.

The programme will be informed by an industrial advisory committee comprising senior engineers from automotive, aerospace and consultancy sectors, who are directly involved with leading lightweight structures related research. Advice from this committee will ensure programme content is up to date, relevant and equips students with the skills and knowledge required by leading employers.

Formative assessments include:

- Technical oral presentations (including technical posters)
- Module based activities (including self-assessment questions)
- Group Discussion / Debate, which may include flipped-classroom teaching (where appropriate)

The teaching team have experience of using technology enhanced learning, which includes the Blackboard Virtual Learning Environment (VLE) (and Blackboard Collaborate for online training), flipped classroom teaching and online assessment and feedback. The VLE will be used to disseminate taught material (including lecture notes, supplementary handouts, etc), providing convenient access when off-site. Hard copies of handouts will also be provided if requested, or where they are more appropriate for module delivery.

All coursework submissions will be online with software-aided plagiarism checking.

Summative assessment strategies and methods to enable learning outcomes to be demonstrated.

Care is taken to ensure a balance between examinations and assignments, which are aligned with overall programme Learning Outcomes. Both approaches have their place at FHEQ Level 7 by assessing different skills sets and provides a fairer reflection on student performance, by recognising the individuality of learners and ensuring assessments do not favour or disadvantage specific groups.

In keeping with best practice, assessment will be criteria based and grades determined upon clearly defined learning outcomes, which are aligned with the overall programme learning outcomes and developed with reference to skill set subject benchmarks.

Each form of assessment has been specifically chosen to constructively align the assessment task, learning activities and learning outcomes, to encourage the right approach to learning by students. Clearly defined marking schemes and model solutions are provided for assignments and exam questions, which are internally and externally scrutinised (through the External Examiner) to check for clarity and alignment to the learning outcomes.

- *Examinations*
Closed book, designed to draw on knowledge across several aspects of the module to allow broader understanding to be assessed through more comprehensive questions.
- *Assignments*
Designed to assess application of knowledge, approaches to problem solving, technical writing and critical evaluation of approach / results on a more detailed problem. Summative and formative feedback will be provided to enable student reflection on their learning and achieved through feedback sheets, or direct annotation onto submitted course work.
- *Dissertation*
A key component, designed to test a candidate's ability to plan and execute a piece of individual research, and critically assess their findings. A system of first supervisors and second markers will be employed for dissertation marking and any major discrepancy between markers will be resolved locally in the first instance. If no agreement, a third marker is used, whose resulting assessment will be final, in-line with standard Departmental practice. The assessment will also include a final project presentation.

In addition, the use of formative assessment (where appropriate) allows staff and student to monitor progress, identify gaps in skills and knowledge and enables a student to take personal ownership of their learning.

25. Programme Structure, progression and award requirements

Programme structures and features: levels, assessment blocks, credit and progression and award requirements

- **Compulsory block:** one which all students registered for the award are required to take as part of their programme of study. These will be listed in the left hand column;
- **Optional block:** one which students choose from an 'option range'. These will be listed in the right hand column;
- A **core assessment** is an assessment identified within an assessment block or modular block (either compulsory or optional) which must be passed (at grade C- or better) in order to be eligible to progress and to be eligible for the final award. All core assessments must be specified on the programme specification next to the appropriate assessment or modular block:

Where students are expected to pass the block at C- or better, but not necessarily all elements, then the block itself is core.

e.g. AB5500 Project (40)
Core: Block

Where only some elements of assessments are required to be passed at C- or better, these will be identified by listing each element that is core

e.g. ABXXX1 Title (XX credits)
Core: 1 & 4

Where students are expected to pass all assessments in a block then this will be identified. By setting the assessment this way, students are also required to pass the block by default. This will be identified thus:

e.g. ABXXXX Title (XX credits)
Core: All, Block

- A **non-core assessment** does not have to be passed at grade C- or better, but must D- or better in order to be eligible for the final award.

Masters and FHEQ Level 7	
Compulsory assessment block codes, titles and credit <u>FULL-TIME: (12 Months)</u> ME5800 Group Project (30Cr) ME5801 Applied Continuum Mechanics and FEA (30Cr) <u>PART-TIME: (24months)</u> <u>Year 1:</u> ME5800 Group Project (30Cr) ME5801 Applied Continuum Mechanics and FEA (30Cr)	Optional assessment block codes, titles and credits
Compulsory study block codes, titles and credit volume	Optional Study block codes, titles and credit volume
<u>FULL-TIME (12 Months) (MSc)</u> ME5703 Structural Mechanics Fundamentals (0Cr) ME5704 Applied Continuum Mechanics 1: Fundamentals (15Cr) ME5705 Applied Continuum Mechanics 2: FEA (15Cr) ME5706 Advanced Transient Simulation Methods (15Cr) ME5707 Impact and Crashworthiness (15Cr) <u>PART-TIME: (24months)</u> <u>Year 1:</u> ME5703 Structural Mechanics Fundamentals (0Cr) ME5704 Applied Continuum Mechanics 1: Fundamentals (15Cr) ME5705 Applied Continuum Mechanics 2: FEA (15Cr) ME5706 Advanced Transient Simulation Methods (15Cr) ME5707 Impact and Crashworthiness (15Cr)	

Compulsory modular block codes, titles and credits	Optional modular block codes, titles and credits
<p>FULL-TIME (12 Months) <i>Compulsory Assessment Blocks (2 x 30Cr)</i> + ME5600 Fracture Mechanics and Fatigue Analysis (15Cr) ME5601 Metallurgy and Materials (15Cr) ME5644 Composite Materials and Structures (15Cr)</p> <p>ME5612 Dissertation (60 Credits) for MSc only Core: Block</p> <p>PART-TIME: (24months) <u>Year 1:</u> <i>Compulsory Assessment Blocks</i></p> <p><u>Year 2:</u> ME5600 Fracture Mechanics and Fatigue Analysis (15Cr) ME5601 Metallurgy and Materials (15Cr) ME5644 Composite Materials and Structures (15Cr) + ONE Optional Module</p> <p><u>Year 2 – TERM 3:</u> ME5612 Dissertation (60 Credits) Core: Block</p>	<p>FULL-TIME (12 Months) <i>Specialist Options – Select:</i></p> <p>ME5645 Thin-Walled Structures (15Cr) <u>or:</u> ME5646 Automotive Integral Vehicle Structures (15Cr)</p> <p>PART-TIME (24months) <u>Year 2:</u> <i>Specialist Options – Select:</i></p> <p>ME5645 Thin-Walled Structures (15Cr) <u>or:</u> ME5646 Automotive Integral Vehicle Structures (15Cr)</p>
Masters and FHEQ Level 7 – “with Internship”	
<p>Compulsory modular block codes, titles and credits</p> <p>ME5647 Internship Core: Block</p>	
Masters and FHEQ Level 7 – “with Placement”	
<p>Compulsory modular block codes, titles and credits</p> <p>ME5648 Placement Core: Block</p>	
<p>Masters and FHEQ Level 7 Progression and Award Requirements</p> <p>As per Senate Regulation 3</p> <p>A PGDip may be awarded by substitution of the dissertation (ME5XXX) for up to 30 credits of modular/assessment blocks in the taught part of the programme, provided the learning outcomes have been met.</p>	

Please note: this specification provides a concise summary of the main features of the programme and the learning outcomes that a student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods can be found in the modular block, assessment and study block outlines and other programme and block information. The accuracy of the information contained in this document is reviewed by the University from time to time and whenever a modification occurs.