Faculty of
Computing, Engineering
and Mathematical Sciences
UWE BRISTOL

M/BEng Aerospace Design Engineering

Definitive Documentation – March 2007

Programme Specification

Section 1: Basic Data

Awarding institution/body	University of the West of England
Teaching institution	University of the West of England
Faculty responsible for programme	Computing, Engineering and Mathematical Sciences
Programme accredited by	
Highest award title	M.Eng/BEng (Hons) Aerospace Design Engineering
Default award title	
Interim award title	Diploma of Higher Education in Aerospace Design Engineering Certificate of Higher Education in Aerospace Design Engineering
Modular Scheme title (if different)	
UCAS code (or other coding system if relevant)	H401
Relevant QAA subject benchmarking group(s)	Engineering
On-going/valid until* (*delete as appropriate/insert end date)	
Valid from (insert date if appropriate)	September 2007

Authorised by… **Date:…**

Version Code
1

Section 2: Educational aims of the programme

The aim of the Faculty's B.Eng/MEng programmes is to respond to the need for effective engineering practitioners by offering programmes that are an intellectually challenging mix of taught engineering science and experiential learning. The practitioner approach is intended to produce engineers with a strong orientation towards problem solving, underpinned by theoretical knowledge.

The aim of this programme is to produce graduates with a broad understanding of Aerospace Design Engineering, combining sound knowledge of the technological fundamentals of the subject with awareness of engineering practice, information technology, management and marketing issues.

Graduates from this programme will be equipped with expertise relevant to the aerospace design process from concept to compliance. The programme of study will cover a broad range of single disciplines such as aircraft design; aerodynamics; structures and materials; propulsion; aircraft performance, control and stability; vibration and aeroelasticity; project management; quality and manufacture. Such single discipline studies will provide the students with the fundamentals in each subject and subject-specific skills in theory, practice and experimentation. Linking these subjects will be a strong inter-disciplinary and multi-disciplinary teaching approach evidenced by lectures, projects, active-learning sessions and international industry contributions. Hence some modules will be specifically devoted to such activities.

It is envisaged that students on this degree programme would also be encouraged to take up opportunities to study and work abroad, gaining valuable inter-cultural skills, which are highly prized by the aerospace companies. These companies rely more and more on international integrated teams.

Section 3: Learning outcomes of the programme

The award route provides opportunities for students to develop and demonstrate knowledge and understanding, intellectual skills, subject-specific skills and transferable skills as shown below

A. Knowledge and Understanding

Knowledge and Understanding of:	Teaching/Learning Methods and Strategies	Assessment
1. the principles governing the behaviour of mechanical components and systems. 2. mathematical methods appropriate to aerospace engineering and related fields. 3. the properties, characteristics and selection of materials used in aerospace components and systems. 4. a sound understanding of core engineering science and manufacturing technologies with greater depth in areas pertinent to aerospace systems. 5. the principles of information technology and data communications from a user's perspective. 6. management principles and business practices. 7. the complexity of large-scale manufacturing systems and projects, with particular emphasis upon aerospace design.	Acquisition of 1 to 7 is through a combination of formal lectures, tutorials, laboratory work, guided project work, group assignments, independent projects and case studies. The programme of study is designed to introduce basic knowledge and understanding of the technologies underpinning aerospace engineering design and product development through a range of level 1 modules. This basic knowledge is developed through a range of taught modules at level 2, and integrated through group design and project work at levels 3 and M. Advanced tools and technologies are studied in the final years of the programmes, and the programme as a whole is integrated through the B.Eng individual project at level 3 or M.Eng individual project at level M. Throughout the programme the student is encouraged to undertake independent reading both to supplement and consolidate knowledge taught/learnt and to broaden their individual knowledge and understanding of the subject. Students on the M.Eng programme are required to demonstrate in-depth understanding and analysis of technical topics, and to carry out a comprehensive literature review in their group design and individual project work.	Testing of the knowledge base is through assessed course work, through tasks undertaken under examination conditions, through oral presentations and assessed practical work done in various laboratories

B. Intellectual Skills

Intellectual Skills	Teaching/Learning Methods and Strategies	Assessment
Students will develop: 1. the ability to produce solutions to problems through the application of engineering knowledge and understanding 2. be able to use scientific principles in the modelling and analysis of aero processes and the inter-relation between processes and materials. 3. the ability to use a broad spectrum of technologies/techniques to solve complex design problems. 4. be able to use scientific/technological principles in the development of engineering solutions to practical problems in the domain of aerospace engineering. 5. the ability to select and apply appropriate computer based methods for modelling and analysing problems in fields relating to the manufacture components and systems, with particular emphasis on the requirements of the aero industries. 6. the ability to understand issues relating to the marketing of products and the management processes associated with their design and manufacture. 7. a professional attitude to the responsibilities of engineering practitioners. 8. the ability to use independent thinking and analysis in the development of engineering solutions. 9. critically review available literature on topics related to aero manufacturing engineering	At all levels students are required to bring together knowledge and skills acquired in several modules and hence determine new ways of working. As the student progresses, the need to synthesise ever greater volumes of information and approaches into a coherent approach is developed and consequently so is their critical thinking. At level 1 analysis, evaluation and problem solving are developed on small-scale problems in various programming activities in a number of modules. Here the focus is on understanding the problem and then solving it free from the environmental implications of real world problems and without the need to examine alternatives and to balance conflicting goals. At level 2 there is a move away from small-scale problems to the design of larger scale systems. With this comes the need to evaluate alternative methods and designs and to balance conflicting objectives. Level 3 sees the move to specific application examples and with it the need to appreciate problem contexts is developed as well as striking the right balance when facing conflicting objectives. Work at level M focuses on skills 8 and 9, and requires independent thinking, information gathering and analysis. This is delivered through a combination of specialist taught modules plus group and individual project work. The development of engineering solutions requires demonstration of all of the intellectual skills. At level 1 the focus is on the skills of Analysis, Evaluation and Problem Solving. At levels 2, 3 and M this branches out to include all the remaining skills. Independent reading is used to enable students to focus on their own areas of interest and in the process ass's skills in submitted reports, assignments and exam answers. Aerospace engineering work requires demonstration of a very wide range of skills.	These skills are assessed through a combination of coursework assessments, projects and examinations

C . Subject, Professional and Practical Skills

Subject/Professional and Practical Skills	Teaching/Learning Methods and Strategies	Assessment
Having successfully completed this programme, students will be able to: 1. use appropriate methods for modelling and analysing problems, particularly aerospace design problems. 2. use relevant design, test and measurement equipment. 3. use experimental methods in the laboratory relating to engineering manufacture and test. 4. demonstrate practical testing of engineering ideas through laboratory work or simulation with technical analysis and critical evaluation of results. 5. use a wide range of computing and information technology systems. 6. demonstrate the ability to apply engineering techniques taking account of industrial and commercial constraints in the domain of aerospace design engineering. 7. execute and manage multi disciplinary projects.	Throughout the programme, the skills listed are developed through a combination of theoretical discussion, practical laboratory based work, classroom based tutorial exercises and directed self-study. Many of the skills listed are introduced at level 1 and then drawn into sharper focus at levels 2 and 3. The general teaching/learning method is therefore to impart these practical/professional skills by a process of moving from an overview of what is required to a specific application of an individual skill at a higher level. Some very specific skills are introduced at level 3. These are underpinned by the more generalised capabilities that are practiced throughout the levels in most of the modules that contribute to the award.	The possession of these skills is demonstrated by the development of practical laboratory work, coursework, presentations and examinations. The practical nature of the skills to be acquired means that some are specifically addressed by particular modules.

D. Transferable Skills

Transferable Skills	Teaching/Learning Methods and Strategies	Assessment
1. Communication skills**:** To communicate orally or in writing, including, for instance, the results of technical investigations, to peers and/or to "problem owners". 2. Self-management skills: To manage one's own time; to meet deadlines; to work with others having gained insights into the problems of team-based systems development. 3. IT Skills in Context To use software in the context of problem-solving investigations, and to interpret findings. 4. Problem formulation: To express problems in appropriate notations. 5. Progression to independent learning: To gain experience of, and to develop skills in, learning independently of structured class work. For example, to develop the ability to use on-line facilities to further self-study. 6. Comprehension of professional literature: To read and to use literature sources appropriate to the discipline to support learning activities. 7. Working with Others**:** To be able to work as a member of a team; to be aware of the benefits and problems which teamwork can bring..	1. Skill one is developed through a variety of methods and strategies including the following: • Students maintain laboratory log books • Students participate in workshops and group work presentation sessions. • Students participate in discussion tutorials • Students present research topic findings in tutorials • Students participate in individual tutorials Skill two is developed through a variety of methods and strategies including the following: • Students conduct self-managed practical work • Students participate in practically-oriented tutorial Skill three is developed widely throughout the programme. Skill four is developed through a variety of methods and strategies including the following: • Students develop problem solving programs • Students practice design and programming • Students express problems in mathematical notation. Skill five is developed through a variety of methods and strategies including the following: • Students are encouraged to practice programming to extend their skills • Students develop problem-solving programs • Students are encouraged to research relevant topics • Students are encouraged to use online facilities to discover information Skill six is developed through a variety of methods and strategies including the following: • Students are encouraged to access a range of material including both printed and online sources • Expected to include literature review in Individual Project Skill seven is developed through a variety of methods and strategies including the following: • Students involved in group projects in a number of modules across the programme.	These skills are demonstrated in a variety of contexts including: • examination • poster presentation. • individual and group projects • practical assignments • portfolio of exercises In particular, a variety of transferable skills are assessed in modules: UFPENX-20-2 Group Project and Management UFPEEL-20-3 Operations & Quality Management UFMEAY-30-3 Individual Project UFMEAY-30-3 MEng Individual Project part A UFPED7-30-M MEng Group Project UFPERY-30-M MEng Individual Project part B

Programme LO against Modules: MEng/BEng (Hons) Aero Design Engineering

Modules (*Modules shown in bold relate only to MEng Aero Design Engineering***)**	UFEE6U-10-1 Electrical Interface	UFMEQT-20-1 Stress & Dynamics	UFMEQU-20-1 Thermodynamics and Fluids	UFPEDA-30-1 Aerospace Engineering Design	UFMEDB-20-1 Materials & Manufacturing Processes	UFQEFH-20-1 Engineering Mathematics 1	UFMEBV-30-2 Fundamental Aeronautics	UFQEFB-20-2 Mathematics for Mechanical Engineering	UFPENX-20-2 Group Project and Management	UFMEEN-20-2 Design Embodiment & Materials Selection	UFMEBS-15-2 Stress Analysis	UFMEBT-15-2 Dynamics	UFMEBX-10-3 Lightweight Structures	UFPEEL-20-3 Operations & Quality Management	UFMEBC-10-3 Aero-Propulsion	UFMEBW-20-3 Applied Aeronautics	UFMECK-10-3 Aerospace Materials	UFMESC-10-3 Aeroelasticity	UFMEAK-10-3 Finite Element Analysis	UFMEAY-30-3 Individual Project/**UFMERX-30-3 MEng Individual Project part A**	**UFMESB-15-M Aerospace Design**	**UFPED7-30-M M. Eng Group Project**	**UFPERY-30-M MEng Individual Project part B**
Knowledge and Understanding																							
The principles governing the behaviour of mechanical components and systems.		X	X							X	X	X	X								X		
Mathematical methods appropriate to aerospace engineering and related fields.		X	X			X		X							X	X		X					
The properties, characteristics and selection of materials used in aerospace components and systems.					X					X							X						
A sound understanding of core engineering science and manufacturing technologies with greater depth in areas pertinent	X			X	X											X					X		

to aerospace systems.																							
The principles of information technology and data communications from a user's perspective.				X						X									X	X	X		
Management principles and business practices.				X					X					X									
The complexity of large-scale manufacturing systems and projects, with particular emphasis upon aerospace design														X							X		
Intellectual Skills																							
The ability to produce solutions to problems through the application of engineering knowledge and understanding	X	X		X												X				X	X	X	X
Be able to use scientific principles in the modelling and analysis of aero processes and the inter-relation between processes and materials.			X			X	X					X	X			X		X					
The ability to use a broad spectrum of technologies/techniques to solve complex design problems.	X								X											X	X	X	X
Be able to use scientific/technological principles in the development of engineering solutions to practical problems in the domain of aerospace engineering.							X		X	X	X	X			X			X					
The ability to select and apply appropriate computer based methods for modelling and analysing problems in fields relating to the manufacture components and systems, with particular emphasis on the requirements of the aero industries.				X						X									X	X	X	X	X

The ability to understand issues relating to the marketing of products and the management processes associated with their design and manufacture.									X					X						X		X	X
A professional attitude to the responsibilities of engineering practitioners.									X					X						X		X	X
Subject/Professional/Practical Skills																							
Use appropriate methods for modelling and analysing problems, particularly aerospace design problems.		X	X	X			X	X	X							X							
Use relevant design, test and measurement equipment.	X									X							X			X	X	X	X
Use experimental methods in the laboratory relating to engineering manufacture and test.		X		X	X						X	X	X				X						
Demonstrate practical testing of engineering ideas through laboratory work or simulation with technical analysis and critical evaluation of results.				X															X	X	X	X	X
Use a wide range of computing and information technology systems.																			X	X		X	X
Demonstrate the ability to apply engineering techniques taking account of industrial and commercial constraints in the domain of aerospace design engineering.									X					X						X	X	X	X
Execute and manage multi disciplinary projects														X						X		X	X
Transferable Skills																							
Communication Skills	X			X	X	X	X	X		X	X	X	X	X	X	X	X		X	X	X	X	X
Self-management skills				X	X	X	X		X	X	X	X	X	X	X				X	X		X	

IT skills in context	X			X	X		X	X	X							X				X	X		X
Problem formulation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X			X
Progression to independent learning	X							X	X								X					X	X
Awareness of professional literature							X				X	X	X		X	X			X		X		
Working with others				X			X									X					X		X

Section 4: Programme structure

Programme Structure for M/BEng Aerospace Design Engineering For October 2007

MEng Year 4

Aerospace Design UFMESB-15-M	MEng Group Project UFPED7-30-M	MEng Individual Project part B UFPERY-30-M	45 credits Option 1

MEng Year 3

MEng Individual Project part A UFPERX-30-3	Lightweight Structures UFMEBX-10-3	Operations & Quality Management UFPEEL-20-3	Aero-Propulsion UFMEBC-10-3	Applied Aeronautics UFMEBW-20-3	Aerospace Materials UFMECK-10-3	Aeroelasticity UFMESC-10-3	Finite Element Analysis UFMEAK-10-3

BEng Year 3

Individual Project UFMEAY-30-3	Lightweight Structures UFMEBX-10-3	Operations & Quality Management UFPEEL-20-3	Aero-Propulsion UFMEBC-10-3	Applied Aeronautics UFMEBW-20-3	Aerospace Materials UFMECK-10-3	Aeroelasticity UFMESC-10-3	Finite Element Analysis UFMEAK-10-3

Year 2P (Industrial Placement Year)

M/BEng Year 2

Fundamental Aeronautics UFMEBV-30-2	Mathematics for Mechanical Engineers UFQEFB-20-2	Stress Analysis UFMEBS-15-2	Dynamics UFMEBT-15-2	Design Embodiment & Materials Selection UFMEEN-20-2	Group Project & Management UFPENX-20-2

M/BEng Year 1

Materials and Manufacturing Processes UFMEDB-20-1	Thermodynamics & Fluids UFMEQU-20-1	Stress & Dynamics UFMEQT-20-1	Aerospace & Engineering Design 1 UFPEDA-30-1	Engineering Mathematics 1 UFQEFH-20-1	Electrical Interface UFEE6U-10-1

Option 1 taken from			
UFMEQS-15-M	Aircraft Systems		
UFMEEA-15-M	Electromechanical Systems Integration	UFMEQR-15-M	Flight Simulation & Control
UFMEEC-15-M	Concurrent Engineering		

PLEASE NOTE: REFER TO THE FACULTY ON-LINE INFORMATION SYSTEM FOR UP-TO DATE STRUCTURE INFORMATION
http://www.cems.uwe.ac.uk/exist/index.xql

Section 5: Entry requirements

The university's minimum requirements for entry to a degree apply to this programme. In addition entrants are required to have A2 level or equivalent in Mathematics, plus A2 Level (or equivalent) in another scientific discipline (for example, physics, chemistry, engineering, design and technology).

Section 6: Assessment Regulations

The Modular Assessment Regulations apply to this programme

Section 7: Student learning: distinctive features and support

Class Activities
The mode of delivery of a module is determined by its Module Leader, and typically involves a combination of one or more lectures, tutorials, laboratory classes, group activities and individual project work. Where modules are common with other programmes, students will typically be taught together (which gives students the opportunity to appreciate the material from the viewpoint of different engineering disciplines). However, a specialist flavour may be given to a common module through the provision of discipline specific practical, laboratory or tutorial material supporting a core of common lectures.

Academic Support
Academic advice and support is the responsibility of the staff delivering the module in question. Staff are expected to be available outside normal timetabled hours, either by appointment or during published "surgery" hours, in order to offer advice and guidance on matters relating to the material being taught and on its assessment.

Virtual Learning Environment
The faculty is in the process of developing its presence on UWEOnline, the university's virtual learning environment. In 2006-07 all modules within the faculty were offered the option of a UWEOnline presence. A staff development process is now in progress to ensure take up by Module leaders where appropriate.

Pastoral Care.
The Faculty offers pastoral care through its Student Advisers, a team of staff who provide comprehensive, full-time student support service on a drop-in basis or by appointment. All students on the same route are allocated to the same Adviser, who is trained to provide advice on matters commonly of concern, including regulatory and other matters; the Adviser will, when necessary, advise the student to seek advice from other professional services including the university's Centre for Student Affairs or from members of academic staff. This support is supplemented by appointment of an academic year tutor who conducts monthly student cohort meetings.

Progression to Independent Study
Many modules require students to carry out independent study, such as research for projects and assignments, and a full range of facilities are available at all sites to help students with these. The philosophy is accordingly to offer students both guided support and opportunities for independent study. Guided support, mainly in the form of timetabled sessions, takes the form of lectures, tutorials, seminars and practical laboratory sessions. Students are expected to attend all sessions on their timetable, and this is especially important because of the high content of practical work in the programme. The progression to independent study will also be assisted by the nature of the support offered in individual modules. Typically, module leaders will provide a plan for the module indicating the activities to be carried out and the forms of learning to be undertaken during the delivery of the module, with a view to encouraging students to plan ahead and to take responsibility for managing their time and resources.

Engineering Facilities
The Faculty offers a wide variety of specialised engineering facilities that will be used during the teaching of this degree. In some cases, these items will be actively used by students, and in other, will be used for focussed demonstrations relating to particular theory or techniques. These facilities include:

- Wind tunnel for three dimensional flow analysis, flow visualisation, and six element strain gauge balance for force measurement;
- Structures laboratory including lightweight structures, advanced composite materials, computer controlled materials testing machines;
- Materials analysis laboratory including scanning electron microscope;

- Water channel for visualisation of three-dimensional flow and turbulence analysis;
- Laser doppler anamometry;
- Vibration analysis rigs;
- Six axis “hexapod” stiffness testing machine;
- CAD suite providing access to SDRC-IDEAS (solid modelling CAD and finite element analysis software);
- Thermofluid heat transfer modelling facilities;
- Computational fluid dynamics packages (CFD);
- Rapid prototyping and fully integrated computer aided manufacture and CNC machining facilities;
- Digital and analogue co-ordinate measuring machinery.

Computing Facilities

The Faculty offers a specialised computing facility along side the general University provisions. There are nine general PC computing laboratories of 20 plus seats all running Windows 2000, along with four Unix based laboratory and 10 specialist computing labs. The specialist laboratories are equipped with specific software for CEMS students, including Software Design Tools development environment, CAD, finite element analysis, mathematics, material and processes selection packages to support the taught program. The specialist Computing laboratories are designed to target the discipline taught in that area. The Unix labs offer the latest web development and programming tools.

Due to the extensive computing facility provided within the Faculty, and the specialist nature of this facility, the need for user support is necessary. The Faculty provides a user support Helpdesk. The Helpdesk provides first line support to the user base, uniquely supported by both permanent staff and students who are in their second or final year of study (employed on a part time basis) until 20.00hrs every day. These general purpose and specialist laboratories are available to students up until midnight, seven days per week.

Section 8 Reference points/benchmarks

In designing this programme, the faculty has drawn upon the following external reference points:
1. The QAA Framework for Higher Education Qualifications in England, Wales and Northern Ireland
2. The QAA Benchmark Statement for Engineering
3. UWE's Learning & Teaching Strategy

The QAA Framework for Higher Education Qualifications in England, Wales and Northern Ireland describes the attributes and skills expected of Honours graduates. It is our view that the learning outcomes of this programme are fully consistent with the qualification descriptor in the Framework, and hence that graduates will be able to demonstrate that they meet the expectations of the Framework.

The QAA Subject Benchmark Statement for Engineering (2006) outlines a set of skills expected of a graduate in an engineering discipline (Section 4 of the Statement refers), while noting that they should be interpreted in the context of the particular engineering discipline which is being studied. These skills map closely to the skills contained in the learning outcomes for this programme, and hence we have confidence that the programme is in accordance with the precepts of the Statement.

For example :
Characteristics of Engineering graduates:
'They will want to solve problems and have strategies for being creative, innovative and overcoming difficulties by employing their knowledge in a flexible manner. They will be numerate and highly computer literate, and capable of attention to detail. They will be cost and value-conscious and aware of the social, cultural, environmental and wider professional responsibilities they should display'.

Teaching and Learning issues: 'significant exposure to hands-on laboratory work and substantial individual project work'

'within MEng programmes case studies, design work and projects are typically utilised more extensively especially during the final year when they build upon the learning of the previous years'

The papers listed below outline current national thinking in respect of the education of aerospace design engineers, and these have played a significant role in the planning and design of this programme.

- European Aeronautics: A vision for 2020, Meeting society's needs and winning global leadership. January 2001, European Commission,

- Jaroslaw Sobieszczanski-Sobieski and Raphael T. Haftka, Multidisciplinary Aerospace Design Optimization: Survey of Recent Developments,1996, Aerospace Sciences Meeting & Exhibit, 34th, Reno, NY.

- AIAA Aerospace America, Annual Review 2006, AIAA

UWE's Learning & Teaching Strategy has informed the faculty's policy for the delivery of its programmes, whose main features are described in section 7.

<u>Employer Interaction</u>
The Bristol Universities' postgraduate aerospace scheme, CPDA, has an Industrial Board which meets twice a year. The Board contains representatives of Industry including the Primes (Airbus, Rolls-Royce, Westlands, MOD), the Supply Chain Representative Organisation WEAF, and the Professional Associations: RAeS and IMechE. The Board's Chairman is from Airbus.

<u>Staff Research Projects</u>
A selection of recent research projects (both completed and in progress) that are relevant to aero-design are:

- Aeroelastic active/passive control for wind turbine blades (Ph.D. completed Ali Maheri)
- Biologically inspired UAV propulsion using dynamic soaring (Ph.D. in progress Markus Deittert)
- Aeroelasticity for supersonic flows. (Ph.D. in progress Sean Tuling)
- an application to FP7 on flow control has been submitted

This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical 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 of individual modules can be found in module specifications. These are available on the University Intranet.

Programme monitoring and review may lead to changes to approved programmes. There may be a time lag between approval of such changes/modifications and their incorporation into an authorised programme specification. Enquiries about any recent changes to the programme made since this specification was authorised should be made to the relevant Faculty Administrator.