### Programme Approval Form

#### Section 1 – The Programme Specification

<table>
<thead>
<tr>
<th>1. Programme title and designation</th>
<th>Space Physiology &amp; Health</th>
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<table>
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<tr>
<th>2. Final award</th>
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<tbody>
<tr>
<td><strong>Award</strong></td>
<td><strong>Title</strong></td>
</tr>
<tr>
<td>MSc</td>
<td>Space Physiology &amp; Health</td>
</tr>
<tr>
<td><strong>Credit value</strong></td>
<td>180</td>
</tr>
<tr>
<td><strong>ECTS Equivalent</strong></td>
<td>90</td>
</tr>
<tr>
<td><strong>Any special criteria</strong></td>
<td>N/A</td>
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<tr>
<th>3. Nested award</th>
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<tr>
<td><strong>Award</strong></td>
<td><strong>Title</strong></td>
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<tr>
<td>N/A</td>
<td>N/A</td>
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<td><strong>Credit value</strong></td>
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<tr>
<td><strong>ECTS Equivalent</strong></td>
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<tr>
<td><strong>Any special criteria</strong></td>
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<th>4. Exit award</th>
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<tr>
<td><strong>Award</strong></td>
<td><strong>Title</strong></td>
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<tr>
<td>PGCert</td>
<td>Biosciences</td>
</tr>
<tr>
<td><strong>Credit value</strong></td>
<td>60</td>
</tr>
<tr>
<td><strong>ECTS Equivalent</strong></td>
<td>30</td>
</tr>
<tr>
<td><strong>Any special criteria</strong></td>
<td>The Postgraduate Certificate will be awarded to students obtaining 60 credits in any combination of modules.</td>
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| PGDip                            | Biosciences               |
| **Credit value**                 | 120                       |
| **ECTS Equivalent**              | 60                        |
| **Any special criteria**         | A Postgraduate Diploma will be awarded to students obtaining 120 credits in any combination of modules. |

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<th>4. Level in the qualifications framework</th>
<th>M</th>
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<tr>
<th>6. Attendance</th>
<th>Full-time</th>
<th>Part-time</th>
<th>Distance learning</th>
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<tr>
<td><strong>Mode of attendance</strong></td>
<td>✓</td>
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<tr>
<td><strong>Minimum length of programme</strong></td>
<td>1 year</td>
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<tr>
<td><strong>Maximum length of programme</strong></td>
<td>2 years</td>
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<tr>
<th>7. Awarding institution/body</th>
<th>King’s College London</th>
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<tr>
<td>8. Teaching institution</td>
<td>King’s College London</td>
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<tr>
<td>9. Proposing department</td>
<td>Physiology Department</td>
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<tr>
<td>10. Programme organiser and contact Details</td>
<td></td>
</tr>
<tr>
<td>Dr. David Andrew Green (PhD)</td>
<td></td>
</tr>
<tr>
<td>Lecturer of Human &amp; Aerospace Physiology</td>
<td></td>
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<tr>
<td>King's College London</td>
<td></td>
</tr>
<tr>
<td>4.4 Shepherds House</td>
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<tr>
<td>Division of Applied Biomedical Research</td>
<td></td>
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<tr>
<td>Department of Physiology</td>
<td></td>
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<tr>
<td>Guys Campus</td>
<td></td>
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<tr>
<td>London</td>
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16. Educational aims of the programme

The aim of this programme is to provide graduates with advanced theoretical and practical training in the physiology, psychology and operational medicine of humans exposed to or working in the Space environment.

The programme will comprise lectures, tutorials and seminars with a large practical component. The latter will provide personal experience and experimental studies of a wide variety of Space-relevant environments including flight, acceleration, heat and cold, noise, and spatial disorientation.

The programme topics will be examined from both scientific and operational perspectives in order that students can evaluate the breadth of investigative approaches employed in human physiology research on earth including experimental models (e.g. animal, computer simulations, and body suspension in addition to space analogues (e.g. underwater, Antarctica and geological environments such as Devon Island).

The programme in Space Physiology & Health will provide a range of multidisciplinary skills and will assist those wishing to pursue a career in human physiology in its broadest sense, in academic research, Ministry of Defence research laboratories, in industry on particular private space ventures e.g. Virgin Galactica, and the National or International Space agencies.
17. Educational objectives of the programme/programme outcomes

The programme provides opportunities for students to develop and demonstrate knowledge and understanding and skills in the following areas:

1. Provide detailed complex and specialised knowledge of the physiological effects of the space environment upon humans and of the methods employed to mitigate such effects.

2. Provide practical experience in experimentation methods appropriate to investigate the physiological effects of the space environment and those employed to mitigate such effects. An advanced knowledge and skill in instrumentation, calibration, data acquisition and the analysis of results whilst applying the appropriate statistical methods.

3. Provide an understanding of the effect of the space environment upon human behaviour and performance.

4. Provide a detailed knowledge of the practical implications of disease and physical deconditioning in space-faring humans and the practices required to counter and manage such events.

5. Provide detailed knowledge of the characteristics and practices associated with medical and life science research environments in space.

6. Through a combination of learning styles students shall develop accountability to academic and experimental decision making.

Knowledge and understanding

The programme will provide a knowledge and understanding of the following:

1. Human physiology in the context of space physiology especially that of the cardiovascular, respiratory, thermal regulatory, musculoskeletal, central nervous, visual and auditory systems.

2. Psychology in the context of space especially crew performance as affected by stress, workload, situational awareness, disturbance of sleep and circadian rhythms; the selection and training of crew personnel; the causation and prevention of human error accidents.

3. Preventive and clinical space physiology and their application to the care of crew and passengers in space agency and commercial space flight; the management of common or anticipatable disorders including communicable diseases in space; medical care in space and the decision and practicality to abort missions.

4. Pathology, toxicology and radiology in the context of space flight including the medical aspects of the management and investigation of craft accidents; the

These are achieved through the following teaching/learning methods and strategies:

The first part of the programme (semester 1) will focus on the theoretical and practical aspects of the cardiovascular, respiratory and neuromuscular systems. Teaching and learning opportunities will be provided through taught lectures which are closely linked to practical sessions.

Tutorial sessions will serve to act as interactive ‘debriefing’ sessions for the practical classes and allow the development of skills for the critical analysis of relevant research papers and the design and conduct of experiments.

Completion of a literature review of a pertinent space-physiology related issue of the students own choosing (following ratification by the module organiser) allowing extension of their interests at an early stage in the programme.

The second part of the programme (Semesters 2) will comprise formal lectures on space physiology, psychology, clinical and
5. The basis and conduct of the physiological training of space crew including the provision of personal experience of altitude hypoxia, sustained +Gz accelerations, spatial disorientation and on occasions, microgravity via participation in parabolic flight campaigns whilst identifying and acknowledging the limitations of each.

6. The design and conduct of experiments in the laboratory and the field including the health and safety and ethical issues of performing experiments on human volunteers; the appropriate methods of measuring human physiological functions and performance and collecting subjective opinions.

**Skills and other attributes**

**Intellectual skills:**

Understanding hypothesis driven science.

How to critically analyse research papers. Identification of salient details from experimental data. Synthesis, integration and evaluation of information and data from a variety of sources. Utilisation of the above skills in the identification and investigation of research questions. Ability to design and apply quantitative and qualitative (as appropriate) experimental protocols. Ability to take a multidisciplinary and integrative approach to issues of human performance. The design and safe execution of scientific experiments with the evaluation of their outcome. The communication, oral and written of scientific experiments.

**Practical skills:**

In semester 1 practical skills in human physiology will be developed which involve the measurement at rest and where operational space medicine, together with personal practical experience of space faring-related stresses and visits to space agency establishments.

The third part of the programme (Semesters 3) is comprised of a space physiology research project a proportion of which shall be at King’s and some with partner institutions with knowledge and expertise in Space Physiology & health.

**Assessment:**

Testing of knowledge and understanding will be through a combination of formative and summative assessment.

**Formative:**

Oral presentations of practical studies

**Summative:**

Unseen examinations

Essays, laboratory reports, oral examinations and dissertation.

These are achieved through the following teaching/learning methods and strategies:

Didactic teaching such as lectures. Participatory teaching such as tutorials and workshops. Participation in, and analysis and interpretation of experimental data in a wide variety of laboratory and practical sessions. Design, implementation, analysis and presentation of a research project.

**Assessment:**

**Formative:**

Feedback from oral presentations.

**Summative:**

In-course written laboratory reports. Unseen written exams. Literature survey based dissertation (3,000 words). Research project thesis (10,000 words).

These are achieved through the following teaching/learning methods and strategies:

In semester 1, these practical skills will be developed through human physiology.
appropriate during exercise, of:
1) Respiratory system; End-tidal gas tensions, respiratory flow, pulmonary ventilation and arterial oxygen saturation in normoxia and hypoxia.
2) Cardiovascular system; ECG, blood pressure, cardiac output & peripheral blood flow.

In semester 2 practical skills in the techniques involved in the investigation of physiology, adaptation and countermeasures in environments of acceleration, deceleration and microgravity.

practicals. These will take place in the Division of Applied Biomedical Sciences. In semester 2 these practical skills will be extended through both lectures and related practicals at King’s. These practical skills will be developed in class. Research experts will share their knowledge in project supervision. These skills will be supplemented during the visit to the European Astronaut Centre and associated institutions.

Assessment:
Formative:
Students will keep an up-to-date laboratory book detailing all their experimental results for all practicals.
Students will be asked to make selective oral presentations on some practicals.

Summative:
Three of the practicals will be written as formal reports (~ 1500 words).
The research project will be written as a dissertation (10,000 words) and the students subjected to an oral examination.

Generic/transferable skills:
- Evaluation of the logical strength of a scientific argument.
- Time management and organisational skills.
- Oral presentation skills.
- Written communication skills.
- Computer skills e.g. e-mail, internet use of search engines/strategies, word processing and spreadsheets.
- Library skills (e.g. synthesise findings).
- Data handling skills.
- Interpersonal skills and group activity skills.
- General laboratory skills.

These are achieved through the following teaching/learning methods and strategies:
- Practical classes and follow-up tutorials and discussions.
- Tutorials.
- Self-directed learning informed by interaction with project supervisors.
- Objective feedback from précis writing, oral presentations and laboratory reports.

Assessment:
Both formative and summative assessment of all oral and written work is undertaken. This includes; laboratory reports, oral presentations, exams and dissertation.

18. Statement of how the programme has been informed by the relevant subject benchmark statement(s)/professional, regulatory and statutory body guidelines
At this time no relevant benchmark statement for space physiology has been produced by the Quality Assurance Agency. The programme refers to the best available alternative source which is the core curricula for degrees (at BSc level) in physiology as defined by The Physiological Society, which is likely to form the basis of any benchmark statement.

Although this is submitted as a new programme, this MSc builds heavily on the foundations of the MSc in Human & Applied Physiology which ran for many years at King’s College prior to 2003 and post 2007. However, there are a number of modifications to its structure and content. These are both

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Programme approval 2008/09

Programme approval 2008/09 to fulfil the new 180 MCAT system operated by the college. Furthermore, the course has being co-developed by the Crew Medical Support Office situated at the European Astronaut Centre and part of the European Space Agency. Their assistance has been both helpful and vital in designing and developing a curriculum appropriate for graduates to go on to careers in Space-related physiology and health.

19. In cases of joint honours programmes please provide a rationale for the particular subject combination, either educational or academic

N/A

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### 20. Programme structure

Please complete the following table and, if appropriate, to include joint, major/minor or other variations

**Code** = code of each module available for the programme

**Title** = title of each module available for the programme, plus its credit level and credit value

**Status** = please indicate whether the module is introductory (I), core (Cr), compulsory (Cp), one or more of however many modules must be passed to progress (CrCp), (P) professional (i.e. module testing skills/competency that has no credit level or value but is a professional body requirement) or optional (O) for each type of programme. For postgraduate programmes use the "single honours" column

**Pre-requisite/Co-requisite** = where appropriate please indicate whether the module is pre-requisite to another module or co-requisite by noting pre or co and the module code that it is pre/co-requisite to.

**Assessment** = please indicate in broad terms the assessment for the module eg written examinations, coursework

(Note: the availability of optional modules may vary slightly from year to year; the following are the modules available at the commencement of the programme)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Level</th>
<th>Credit Value</th>
<th>Status (I, Cr, Cp, CrCp, P, O) for each type of module</th>
<th>Pre-requisite/ Co-requisite (Please note the module code)</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<td></td>
<td>Single</td>
<td>Joint</td>
<td>Major/Minor</td>
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<tr>
<td><strong>Full-time Study</strong></td>
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<tr>
<td><strong>First Year</strong></td>
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<tr>
<td>7BBLM004</td>
<td>Cardiovascular and Respiratory Physiology from rest to exhaustive exercise (BLM004)</td>
<td>7</td>
<td>30</td>
<td>Cr</td>
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<tr>
<td>7BBRMN02</td>
<td>Muscle and Exercise Physiology</td>
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<td>15</td>
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<td>7BBLM014</td>
<td>Library Project in Space Physiology &amp; Health</td>
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<td>15</td>
<td>Cr</td>
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<tr>
<td>7BBLM015</td>
<td>Human Aerospace Physiology</td>
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<td>15</td>
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<td>45</td>
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<tr>
<td>7BBLM017</td>
<td>Research Project in Space Physiology &amp; Health</td>
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<td>Cr</td>
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If a Masters programme, are level 6 credit levels permitted within the programme?

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No

| Maximum number of credits permitted with a condoned fail (core modules excluded) | 0 |
| Are students permitted to take any additional credits, as per regulations A3? | No |
| Are students permitted to take a substitute module, as per regulations A3? | N/A |

**Are there any exceptions to the regulations regarding credits, progression or award requirements?** (where relevant the information should also differentiate the particular requirements of pathways within a programme or nested/exit awards)

No

**Other relevant information to explain the programme structure**

*Please note that new students enrolling on the information provided on this section of the PAF will have these regulations stipulated throughout their programme of study. The only exception to this will be if there are changes made by Professional, Regulatory or Statutory Bodies that are noted to this programme.*

Students must pass all modules with an overall mark of 50% in each in order to be awarded the MSc. The percentage weighting for the calculation of merit and distinction will directly reflect the proportion of credits allocated to each module in relation to the overall credit taken within each programme/award, with classification thresholds set according to the core scheme as set out in the “Credit Framework Regulations” of King’s College London.

A Postgraduate Diploma will be awarded to students obtaining 120 credits in any combination of modules. The Postgraduate Certificate will be awarded to students obtaining 60 credits in any combination of modules.
20. Marking criteria
The guideline criteria in the table below are for assessing essays and examinations, but are applied generally to all forms of assessment.

As per School of Biomedical & Health Sciences criteria

21. Particular features of the programme which help to reduce the barriers experienced by disabled students and ensure that the programme is accessible to all students who meet the entry requirements

Admissions
All students in receipt of an offer receive an information booklet on the support services offered by the College.

All students receiving offers who have indicated they have a disability in their application receive a letter from the School Disability Adviser with her contact details and offering the applicant the opportunity to discuss their requirements. They are also invited to complete and return a ‘Support Details Form’ to outline the support they require so that this can be put in place prior to their arrival.

Publicity and Course Booklets
These clearly communicate the key skills that will be required during the programme, the content of each module, the intended teaching methods to be used and module status (core/compulsory/optional).

Teaching Methods
A wide range of teaching methods is utilised (as demonstrated by box 17).

Assessment
Advice has been taken from the Equality & Diversity Department to ensure assessment methods do not unfairly discriminate against students with disabilities. The College’s Special Examination Assessment Committee (SEAC) considers requests for adjustments to assessment to take account of learning and/or physical disabilities. Module outlines specify the assessment methods that will be used and explain that SEAC will need to be notified about requests for alternative assessment methods. The form that the alternative assessment will take has been specified for each module in advance.

Feedback
Feedback on the programme is regularly collected from students about their learning experience. The information collected is used towards the on-going development and improvement of the programme. In particular, it has prompted closer working with ISS to ensure that subject resources are offered in a range of alternative formats wherever possible.
### Programme Approval Form

**SECTION 2 – SUPPLEMENTARY INFORMATION**

Not all of the information in this section will be relevant for all programmes and for some programmes this section will not be relevant at all.

<table>
<thead>
<tr>
<th>1. Programme name</th>
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<tbody>
<tr>
<td>Space Physiology &amp; Health</td>
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<tr>
<th>2. Is this programme involved in collaborative activity?</th>
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<tr>
<td>Yes [ ] No X</td>
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</table>

If yes what type of Collaborative Provision is it *(tick appropriate box)*?

<table>
<thead>
<tr>
<th>Does the programme have an access/feeder Programme for entry into it?</th>
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<table>
<thead>
<tr>
<th>Does the programme have an articulation/progression agreement for entry into it?</th>
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<tr>
<th>Dual Award</th>
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<th>Franchised Provision</th>
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<tr>
<th>Joint Award</th>
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<tr>
<th>Partnership Programme</th>
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<table>
<thead>
<tr>
<th>Recognition of Study or Award of Credit through off-campus study or placement</th>
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<table>
<thead>
<tr>
<th>Staff and student exchange</th>
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<tr>
<th>Validated provision</th>
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Have the relevant stages and appropriate paperwork been approved and the paperwork forwarded onto QA&AA Office?

| Yes [ ] No [ ] Not applicable X |

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7. In cases where parts or all of the programme (other than those in box 4 above) are delivered either away from one of the College campuses and/or by a body or bodies external to the College please provide the following details.

The programme will include one to five day visits to external organisations where the students will be given lectures on, practical experience and demonstrations of relevant space physiology stresses and the practice of space crew medicine support.

Name and address of the off-campus location and/or external body and amount of the programme delivered off-campus or by external body.

A. Visits of ½ or 1 day -

1. RAF Centre of Aviation Medicine (1-3 days)
   Royal Air Force Henlow
   Bedfordshire
   SG16 6DN

2. Qinetiq (1 day)
   Human Protection and Performance Enhancement
   Cody Technology Park
   Ively Road
   Farnborough
   Hampshire
   GU14 0LX

3. Department of Movement & Balance
   Imperial College London,
   Charing Cross Hospital,
   Hammersmith,
   London
   W6 8RF

B. Visits longer than 1 day

5 day stay in Cologne based at:

4. Crew Medical Support Office
   European Astronaut Centre
   Linder Höhe
   Cologne, 51147
   Germany

   The 5 days will also incorporate (subject to change) short visits to:

5. European Space Research & Technology Centre,
   Keplerlaan 1
   Postbus 299
   2200 AG Noordwijk
   The Netherlands

6. DLR (German Space Agency)
   Headquarters DLR
   Linder Höhe
   Cologne, 51147
7. Cologne Sports University (DSHS)
Am Sportpark
Muengersdorf 6
50933, Cologne.

Others institutions & organisations have expressed an interest but details remain to be confirmed.

Nature of involvement of external bodies –

1. RAF Centre for Aviation Medicine
The involvement of RAF CAM will be two fold. Firstly, it will provide the facilities lecture room, visual aids etc for visiting lecturers. All the latter will be selected and appointed by the Module Organiser. Secondly, the members of the staff of RAF CAM will provide the tuition listed below. The members of the staff of RAF CAM who will conduct this tuition will be approved by the Module Organiser in consultation with the officer commanding the Aviation Medicine Wing, RAF CAM (who is a Visiting Professor at KCL).

1) Personal experience of hypoxia in hypobaric chamber
2) Personal experience of pressure breathing
3) Demonstration of aircraft oxygen equipment
4) Practical – measurement of noise
5) Personal experience of spatial disorientation
6) Practical – anthropometric measurement
7) Experience in Spatial Disorientation Familiarisation Devices

2. QinetiQ
Members of the staff who will conduct this tuition will be approved by the Module Organiser in consultation with the officer commanding the Aviation Medicine Wing, RAF CAM (who is a Visiting Professor at KCL).

1) Personal experience of +Gz acceleration on man carrying centrifuge
2) Personal experience of whole body vibration on vibrator
3) Personal experience of spatial orientation/disorientation

3. Imperial College London
Visit is to be organised by Dr Green who holds an honorary contract with the department.

1) Personal experience of Off-vertical axis rotation (OVAR) i.e. corrolis effect.
2) Personal experience of OVAR and visually induced spatial disorientation

4. Crew Medical Support Office:
This part visit is to be organised and run by a member of the Crew Medical Support Office who is an ex-KCL lecturer and who holds a higher education teaching qualification (PG Cert). The students will also be accompanied by KCL staff (usually Dr. David A Green) throughout.

1) Space medicine and life science laboratories
2) Space medicine operations consoles
3) Exercise science equipment associated with space e.g. Flywheel Exercise Device.
4) Space medicine/life science library
5) Some years parabolic flight microgravity facility.
5. ESTEC
   1) Exact content still TBD.

6. DLR (German Space Agency)
   1) Short Arm Human Centrifuge familiarisation

7. Cologne Sports University for Space Exercise demo
   1) Exact content still TBD.

Descriptions of learning resources available at the off-campus location

1. RAF Centre for Aviation Medicine
   Large, fully equipped lecture theatre dedicated to the module and the DAvMed Course.
   Very extensive aviation medicine and occupational medicine library with online facilities and
   full-time librarian. Equipment, staff and MoD approved training procedures for exposures to altitude
   including hypobaric and hyperbaric chambers; for experience of pressure breathing, spatial
   disorientation, night vision devices, noise measurement, anthropometric measurement, accident
   investigation and cockpit ergonomics. Very good learning and social facilities for students.

2. QinetiQ
   Man carrying centrifuge equipped with G protective systems, closed circuit television
   monitoring and physiological monitoring. Neurokinetic chair and Norris turntable.
   Recording of eye movements (ENG). Whole body vibrator with measurement of visual
   acuity and body resonances.

3. Imperial College London
   Man carrying off-vertical axis rotation (OVAR) in birany chair i.e. corrolis effect and
   visually induced spatial disorientation.

4. Crew Medical Support Office (European Astronaut Centre) has space medicine and life
   science laboratories, European Medical Mission Control Centre with telemedicine links to
   the International Space Station (ISS) and ISS environmental conditions access, exercise
   science equipment associated with space e.g. Flywheel Exercise Device, an excellent space
   medicine/life science library and access to a short-arm human centrifuge (DLR). Quite
   simply, it is the hub of European Space Medicine expertise.

What mechanisms will be put in place to ensure the ongoing monitoring of the delivery
of the module?

1. RAF Centre for Aviation Medicine
   Content and quality of the contributions to the module are controlled by and will be
   reviewed annually by the Module Organiser and the officer commanding the Aviation
   Medicine Wing who is a Visiting Professor at King’s College London.

2. QinetiQ
   Experience on the human carrying centrifuge will be conducted by a RAF Consultant in
   Aviation Medicine who is a Visiting Senior Lecturer at King’s College.
   Practicals on spatial orientation/disorientation and whole body vibration will be conducted by
   the physician who lectures on these topics at King’s College.
   The contract which defines the tuition provided at QinetiQ will be reviewed annually by
   the Module Organiser.

3. Imperial College London
   Content and quality of this contribution to will be controlled by Dr Green.
Research Projects:

1. The local supervisor of a Space Physiology & Health Research Project conducted at RAF CAM will be an appropriate RAF Consultant in Aviation Medicine who will in addition to his medical degree have the Diploma in Aviation Medicine and a PhD degree and will in all probability be a visiting Senior Lecturer at KCL.

2. The local supervisor of a Space Physiology & Health Research Project conducted at CSMO will be an ex-KCL lecturer who holds a doctorate from KCL and a higher education teaching qualification (PG Cert).

3. Dr Green and Dr. Russomano may offer project using the resources both at KCL but also Imperial College and Microgravity Laboratory, PUCRS, Porto Alegre, Brazil.

4. The CSMO will also act as a hub for projects in Space Physiology & Health Research at host institutions and organisations within Europe.

5. In addition to a local vetted supervisor all students shall also have a supervisor at KCL.

Current partners that have no obligation to host project on any particular year but who have agreed to host when possible include:

- ESA MedOps (Cologne, Germany)
- Profil Research (Düsseldorf, Germany)
- Damec (Odense, Denmark)
- OHB (Bremen, Germany)
- Vehaert Space (Kruibeke, Belgium)
- OEWF (Innsbruck, Austria)
- MEDES (Toulouse, France)
- ESTEC (Noordwijk, The Netherlands)
- TNO Defence (Delft, The Netherlands)
- DLR (Cologne, Germany)

Percentage of the programme delivered off-campus or by external body

This will vary according to where the research project is conducted but not more than 20%.

Any such external institution will provide a suitably qualified and experienced local supervisor and some or all of the facilities required for the conduct of the research. The acceptability of a proposed institution and research project will also be assessed and approved by the Module Organiser.