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VALIDITY

1. The information in this Course Handbook should be read in conjunction with the General Regulations for Higher Awards of the University for Students Pursuing Programmes on a Modular Basis.

2. The information contained within this Course Handbook is believed to be accurate at the time of production but the University and the Faculty cannot be held responsible for errors, omissions or changes which may have occurred.

3. The information in this Course Handbook will be amplified during the course with the issue of additional material.

   This additional material shall be read as part of the overall Course Guidelines and is considered to be part of the requirements of the Course which the student is expected to satisfy.

4. The course regulations governing performance requirements for the assignments, examinations and dissertation will be implemented within the scope of the General Regulations.

INTRODUCTION

This Handbook aims to describe the structure of the University of Surrey MSc course in Radiation Detection and Instrumentation (RDI). As well as providing information on the academic course elements and requirements, it also summarises general relevant regulations.

The Department of Physics has approximately 140 postgraduate students, 25 academic staff, 20 support staff and 30 research fellows, all of whom are involved in our wide-ranging research programme.

Roughly 40% of the Department's students are postgraduates, studying for either MSc or PhD degrees. This proportion of postgraduates, one of the highest in UK physics departments, reflects the Department's strength in research (rated 5A at the last research assessment exercise). Our well-established MSc courses in Medical Physics and in Radiation and Environmental Protection, which complement the RDI programme, have gained depth from our research. The use of external lecturers, who are specialists in their fields, adds a significant strength to our teaching capability.

Radiation Detection and Instrumentation (RDI) is a new MSc programme which is designed to complement the Physics department's two existing MSc programmes in Medical Physics (MP) and Radiation and Environmental Protection (REP). The aim of the RDI MSc is to provide training and expertise in the use of radiation detectors, instrumentation techniques and data processing, and their application across a range of fields including medical physics, nuclear and particle physics, astronomy, and homeland security. The course is developed out of the department's expertise in radiation detection and instrumentation, led by Dr Paul Sellin, and our existing strong links with industry and government institutes in the areas of radiation physics, environmental monitoring, and detector technology.

Various industrial sectors use radiation detection as a core technology, ranging from medical imaging, security and baggage scanning, the nuclear power industry, the defence services and scientific research organisations (specifically nuclear physics, high energy physics, and space science). There is currently a particular renewed interest in nuclear power and remediation work, and also in homeland security and counter terrorism activities. The department has long-standing associations with many of the major industries and institutes in the sector, specifically:-

- **industrial collaborations** (joint research projects, MSc and PhD studentships) with detector companies; Ortec, Canberra, Micron Semiconductor.

- **government institutes** (MSc and PhD studentships, research collaborations, professional training placements); Health Protection Agency, formerly NRPB, National Physical Laboratory, HMS Sultan, regional hospitals, IAEA.

- **sponsorship MSc students** (studentships, prizes, visiting lecturers, equipment donation, project placements); together with our established REP and MP MSc programmes we have long-standing contacts and sponsorship from companies primarily in the radiation protection and nuclear safety industries; e.g. Atkins, AWE, GE Healthcare, Thermo Fisher.

We wish you all a happy and successful time with us at Surrey.

SECTION A – WHO's WHO IN THE MSc RDI PROGRAMME

COURSE SUMMARY

The University of Surrey MSc in Radiation Detection Instrumentation is offered either as a one-year full-time course or as a two-year part time course, designed to provide the student with a detailed training in the performance, characteristics and application of radiation detectors and associated instrumentation across a broad range of application areas.

Students successfully completing the course are awarded an MSc in Radiation Detection and Instrumentation. For students who do not achieve the full 180 credits, alternative awards of Postgraduate Diploma in Radiation Detection and Instrumentation or Postgraduate Certificate in Radiation Physics may be offered.

The following staff members are principally involved in the organisation of this course:

Dr Paul Sellin
Course Director
Room 28BC04
e-mail: p.sellin@surrey.ac.uk
Telephone: 01483 686814

Dr Gary Royle
External Examiner
University College London
Department of Medical Physics and Bioengineering

Miss Alexia Smith
MSc Course Administrator
Room: 04AA02
e-mail: a.m.smith@surrey.ac.uk
Telephone: 01483 686133

LECTURING STAFF

The course is taught by a number of specialists, who are either staff at the University of Surrey or are based in industries related to radiation detection and instrumentation. The following paragraphs list the course lecturers and their affiliation.

University of Surrey:

Dr. David Bradley, Reader, Physics Department
Prof. Wilton Catford, Physics Department
Dr Walter Gilboy, Visiting Senior Fellow, Physics Department
Prof. Andrew Nisbet, Professor, Physics Department and Royal Surrey County Hospital
Dr Zsolt Podolyak, Senior Lecturer, Physics Department
Prof. Patrick Regan, Physics Department
Dr Paul Sellin, Reader and Course Director, Physics Department
Prof. Nicholas Spyrou, Physics Department

University of Sussex:

Dr Seb Oliver, Reader, Physics and Astronomy Department, Sussex University
Dr Anthony Smith, Research Fellow, Physics and Astronomy Department, Sussex University
Dr Pascale-Fabrizio Salvatore, Lecturer in Experimental Particle Physics, Physics and Astronomy Department, Sussex University

External Lecturers:

Mr Pete Burgess
Nuvia Ltd, B351.15, Harwell Science & Innovation Campus, Didcot, Oxfordshire OX11 0RA
Lectures on Module 4: Imaging and Remote Sensing

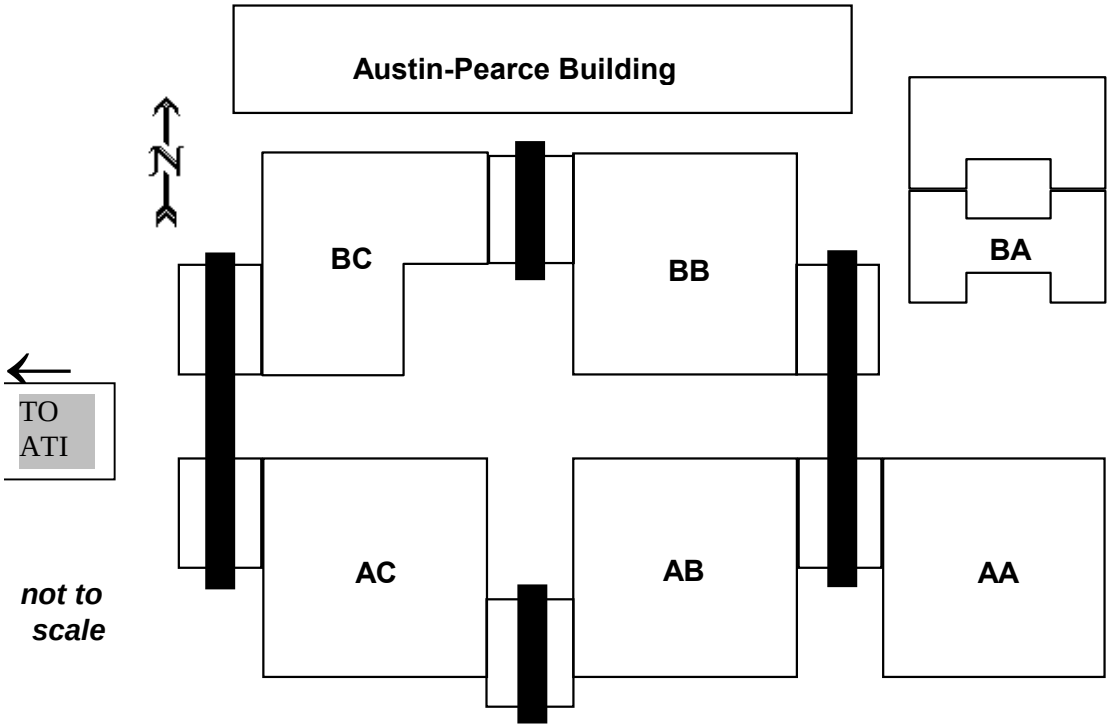
Dr Ian Jupp
DSTL, Fort Halstead, Sevenoaks, Kent TN14 7BP
Lectures on: Module 4: Imaging and Remote Sensing

Dr James Parkin
Lab Impex Systems Ltd, Impex House, 21 Harwell Road, Nuffield Industrial Estate, Poole, Dorset BH17 0GE
Lectures on: Module

Mr Paul Seller
Rutherford Appleton Laboratories, Harwell Science & Innovation Campus, Didcot OX11 0QX
Lectures on: Module 3: Detector Instrumentation

SECTION B – GENERAL INFORMATION REGARDING THE PROGRAMME

Physical location: where we are



Postgraduate Teaching Support Office (PGTSO)
The PGTSO (04AA02) is where the MSc Administrator (Alexia Smith) can be found. All routine queries from students and matters relating to students can be dealt with here.

Student Common Room
This is located in 28BB03. A quiet room is located in (30BB04), with facilities for private study and network connections.

MSc RDI Notice Board
The MSc RDI noticeboard is in the Physics Department Student Common Room (28BB03).

Mail
The MSc pigeonholes are located in the Physics Department Student Common Room (28BB03).

URN (University Registration Number)
To use any University facility you will need a Student Card coded with your University Registration Number (URN). If you did not receive a registration form before induction, go to the Student Centre and register. They will give you the required paperwork to take to the library, who provide you with a Card.

Telephones
Departmental telephones may be used in connection with MSc work or in an emergency.

Departmental Library
The Departmental Library (29BB03) is well stocked with relevant books, PhD theses and MSc dissertations. These are all available on loan. Students should contact the Physics Departmental Office (06BB03) for details of this procedure.

University Library
The University Library holds journals and many course textbooks. Most of these may be borrowed using the University Library Card. This card is issued to the students upon registration and contains their University Registration Number (URN).

Access to Buildings
Normal weekday hours are 07:30 to 19:00. A library card will be issued during registration that will give you access to the buildings. After the first few weeks authority may be given to you to access the computer rooms in the department or the main computer unit after 19.00 hours and at all weekend and holiday periods, please ask at the Faculty Reception (02BB04).

Late / Weekend Working
Students wishing to obtain late and / or weekend access to the facilities in the department must apply to the School General Office (01BB04). The process usually takes 48 hours.

Computers
The University Registration Number (URN) allows access to all University computer facilities. These include an extensive range of PC and UNIX terminals, full internet access and e-mail. Students are encouraged to make full use of these facilities. The University has invested in an online resource to allow students to develop their IT skills within a number of Microsoft packages including Word, Excel, Access, Powerpoint, Outlook, and Internet Explorer. This material is available to UniS staff and students both on and off campus at: http://www.surrey.ac.uk/computingservices/as/cbt/. Computers are located in the dedicated computer rooms: Duck Lab (34aBB04), Penguin Lab (32BB03) and Whale Lab (34BB03). Access to these rooms is available 24 hours per day if the student has been granted late and/or weekend access to the building (see below). Students need both a username and password in order to use the facilities. Students are given information explaining the procedure upon arrival. Full online support and information is available at http://www.eps.surrey.ac.uk/SCS/.

Computer Terminal Rooms
These are mostly on levels BB04 and BB03. There are four main computing labs that are for use by students within the Faculty. They are located in 34BB04, 34aBB04, also 32Bb03 and 34BB03 (see website http://www.ee.surrey.ac.uk/SCS/facilities/labs.html). These labs are sometimes booked for classes (timetables are displayed outside the labs), but you may use these labs at other times, they are open 24 hours a day. These facilities are n addition to the University's central computing facilities.

If you have a computing problem you will need to speak to one of the Computing support staff. They prefer you to contact them via a 'web request' from the Faculty Computing Services (SCS) web pages at http://www.ee.surrey.ac.uk/SCS/help. They provide an efficient service when problems are reported in this way. There is also further information here regarding the Faculty's computing facilities. Alternatively, you can contact them by e-mail at problems@ee.surrey.ac.uk. If you need to see a computing officer in person, you can do this by visiting the Faculty Computing Office in 26BB03; Office hours are from Monday-Friday 09.00 – 17.00.

Postgraduates are entitled to print up to 500 pages per academic year, free of charge, on the Faculty printers. Extra pages above this limit will be charged at £4 per 100 sheets. If the 500 limit is reached students will be warned by email.

The University's central computing facilities are provided by IT Services. Services available to you include email, Ulearn, Athens, central filestore and access to the campus network from halls of residence. They also provide various large PC areas, which are available 24 hours a day 7 days a week, with PCs running Windows XP with scanning and CD writing facilities.

IT Services is mainly based in the Austin Pearce Building (AP) but you can also access facilities across campus including the Library. IT Services has a Help Desk in the AP building and the 1st floor of the library (semester only) which provides user-support to all students. The services offered to students are detailed on the IT Services web site at http://portal.surrey.ac.uk/itservices/ and e-mail contact is available via student-support@surrey.ac.uk.

The University has invested in an online resource to allow students to develop their IT skills within a number of Microsoft packages including Word, Excel, Access, Powerpoint and Outlook. This material is available to UoS students both on and off campus at: http://portal.surrey.ac.uk/itservices/as/training/online/onlineskills

Notices via Email
MSc notices will be sent to each students University e-mail account, and also posted on ULearn. Students should check their University e-mail account regularly, since job advertisements and other course information is posted there.

Change of Address
The MSc Administrator should be informed immediately of any change of address and/or telephone number.

Name on Transcript
The name recorded on any transcript or certificate issued by the University will be the name in which the student was last registered. It is your responsibility to notify the University Registry at the first opportunity if your name is not recorded correctly and not later than the date of the Student Progress and Assessment Board at which your award is considered.

Attendance
Attendance at all formal lectures and classes is expected. Persistent absence can be grounds for course termination (see Section D). In case of sickness or other personal difficulties students should contact the Course Director and their personal tutor as soon as possible. A letter or certificate from a general practitioner should be sent to the Course Director if assessment may be affected by ill health.

Timetables
These are available from the Postgraduate Office on the first day of each semester. A copy is also posted via e-mail to each student.

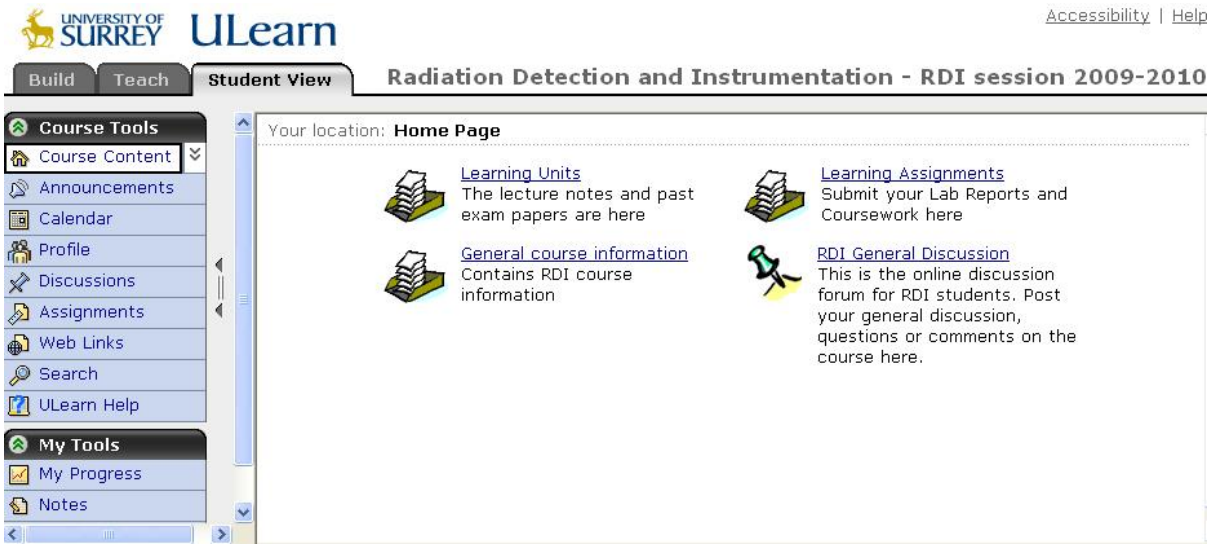
Coursework
Coursework should be handed to the MSc Administrator before each deadline, as outlined in Section D.

Calculators
The only University approved calculators are Casio Models FX115MS, FX115W or FX115S.

Photocopying
Access to the department photocopier can be arranged through the Physics Department Administrator, Cristobel Soares-Smith in 06BB03.

Online Materials and ULearn
All lecture notes and past examination papers are available online via the RDI pages on the University ULearn website: ulearn.surrey.ac.uk.

The ULearn website also provides other tools to help RDI students, including an RDI online discussion forum, general course information, and reminders of key course deadlines. Students are recommended to check their ULearn page regularly. ULearn is also used for some coursework submission, eg. Labview and Monte Carlo computing coursework, and students may optionally submit their lab reports via ULearn if they wish.



Teaching Staff
Physics Department teaching staff and personal tutors are available to discuss coursework directly with students. Questions for external lecturers should be prepared for the teaching sessions at which the lecturer is present. At other times, external lecturers should only be contacted through the Course Director and / or the MSc Course Administrator.

Personal Tutoring System
Each student will be assigned a personal tutor from the academic staff members within the Physics Department. Students can also arrange to see the Course Director should they wish to discuss any problem or idea relating to the course in general.

Coffee Club
Students may join the Physics Department Coffee Club by contribution of a monthly membership fee.

University Student Handbook
The University Student Handbook, which should have been sent to you with your joining instructions, contains general information about different aspects of life as a postgraduate student at the University. As well as containing useful advice, the Handbook supplies the names and telephone numbers of those people who can help you further.

Staff Student Liaison Committee
The MSc Staff Student Liaison Committee (SSLC) exists for the purpose of obtaining feedback from students on any aspects of the MSc programmes, so that improvements can be discussed and potential problems avoided.

A representative from each course run in the Physics department is invited to attend a Staff Student Liaison meeting. The student SSLC members are also PGBoS (PG Board of Studies) members and are expected to attend the PGBoS meetings held approximately twice a semester.

SSLC student members should aim to represent the collective views of students within their group. The student representatives are theoretically chosen from among the variety of courses but due to the relatively short length of study, in practice, there tend to be only a few active volunteers who come forward. The committee meetings take place twice each semester over lunch and they discuss problems that may be affecting the students. All students are expected to raise any issues they have via their SSLC representatives.

IMPORTANT DATES

MSc Induction Week:	28 September to 2 October 2009
MSc RDI Taught Course Commences:	Monday 5 October 2009
Term 1 ends:	Friday 18 December 2009
Deadline for submission of the first 2 Laboratory Reports	**Friday 20 November 2009**
Deadline for submission of ALL Laboratory Reports:	**Friday 5th February 2010**
Christmas Vacation:	Friday 18 December 2009 to Sunday 10 January 2010
Semester 1 ends	Friday 5 February 2010
Semester 2 begins:	Monday 8 February 2010
Term 2 ends:	Friday 26 March 2010
Easter Vacation:	Friday 26 March 2010 to Sunday 25 April 2010
Term 3 starts:	Monday 26 April 2010
Submission deadline for Design Project:	**Friday 21 May 2010** (tbc)

Examinations
May 2010*

*Provisional dates to be confirmed.

Examinations (duration of two hours in each case) will comprise of six questions of which four must be attempted; each question is equivalent to 25% of the full marks available on a given paper.

Dissertation Project

Commence 3rd / 4th week of June
Deadline for submission of Dissertation Project: Friday 10 September 2010

Examination papers I to VI (duration of two hours in each case) will comprise six questions of which four must be attempted; each question is equivalent to 25% of the full marks available on a given paper with the total marks for each paper given for the four best answers.

The marking scheme for Laboratory Reports and the Dissertation project are outlined in Appendix A.

SECTION C - PROGRAMME OBJECTIVES AND OUTCOMES

The detection and analysis of radiation plays a vital role in our modern society, with direct relevance to a wide range of application areas including environmental monitoring, X-ray scanning and security applications, medical physics, nuclear power industries, and synchrotron imaging. In addition, various active areas of physics research make extensive use of radiation detectors and associated instrumentation, including astronomy, particle physics and neutron physics.

Recent trends in employment and government policy indicate that there is significant growth in demand for graduates with postgraduate training in radiation and nuclear skills, and associated instrumentation. The RDI programme is designed to meet these needs, for students who either wish to develop a career in industry, or who want to carry out further research using radiation detection techniques.

The course benefits from the flourishing departmental research programmes in fundamental and applied nuclear physics and in radiation physics, and complements our existing well-established MSc programmes in Radiation and Environmental Protection (REP) and Medical Physics (MP).

The course is largely physics based and is suitable for graduates with good honours degrees in physics or electronic engineering, or in other combinations of subjects with a physical science content. Students with alternative first degrees, or equivalent accredited prior learning, will be considered on a case-by-case basis. We guide the private study of our non-physics entrants and monitor their progress in the first part of their studies.

Programme outcomes
In line with the University Descriptor for a qualification at Masters (M) level, (see page D-53 University of Surrey Calendar 2006-7, *Framework for Higher Education Qualifications, QAA, January 2001)* students graduating from the MSc in Radiation Detection and Instrumentation should be able to demonstrate:

Subject knowledge and skills
- A systematic understanding of radiation detection and instrumentation in an academic and professional context together with a critical awareness of current problems and / or new insights.
- A comprehensive understanding of techniques applicable to their own research project in Radiation detection and / or instrumentation.
- Originality in the application of knowledge, together with a practical understanding of radiation-based, experimental research projects.
- An ability to evaluate and objectively interpret experimental data pertaining to radiation detection.
- Familiarity with generic issues in management and safety and their application in a professional context.

Core academic skills
- The ability to plan and execute under supervision, an experiment or investigation and to analyse critically the results and draw valid conclusions from them. Students should be able to evaluate the level of uncertainty in their results, understand the significance of uncertainty analysis and be able to compare these results with expected outcomes, theoretical predictions and/or with published data. Graduates should be able to evaluate the significance of their results in this context.
- The ability to evaluate critically current research and advanced scholarship in the discipline of radiation protection.

- The ability to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data, and communicate their conclusions clearly to specialist and non-specialist audiences.

Personal and key skills

- The ability to communicate complex scientific ideas, the conclusions of an experiment, investigation or project concisely, accurately and informatively.
- The ability to manage their own learning and to make use of appropriate texts, research articles and other primary sources.
- Responsibility for personal and professional development. Ability to use external mentors for personal / professional purposes.

On successful completion of the **PGDip,** it is intended that students should be able to demonstrate:

Subject knowledge and skills

- A systematic understanding of radiation detection and instrumentation in an academic and professional context together with a critical awareness of current problems and/or new insights.
- Originality in the application of knowledge, together with a practical understanding of radiation-based, experiments.
- An ability to evaluate and objectively interpret experimental data pertaining to radiation detection.
- Familiarity with generic issues in management and safety and their application in a professional context.

Core academic skills

- The ability to plan and execute under supervision, an experiment and to analyse critically the results and draw valid conclusions from them. Students should be able to evaluate the level of uncertainty in their results, understand the significance of uncertainty analysis and be able to compare these results with expected outcomes, theoretical predictions and / or with published data. Graduates should be able to evaluate the significance of their results in this context.
- The ability to deal with complex issues both systematically and creatively, make sound judgements in the absence of complete data and communicate their conclusions clearly to specialist and non-specialist audiences.

Personal and key skills

- The ability to communicate complex scientific ideas, the conclusions of an experiment, investigation or project concisely, accurately and informatively.
- The ability to manage their own learning and to make use of appropriate texts, research articles and other primary sources.
- Responsibility for personal and professional development. Ability to use external mentors for personal / professional purposes.

On successful completion of the **PGCert,** it is intended that students should be able to demonstrate:

Subject knowledge and skills

- An understanding of radiation detection and instrumentation in an academic and professional context together with a critical awareness of some current problems.
- Originality in the application of knowledge, together with a practical understanding of radiation-based experiments.
- An ability to evaluate and objectively interpret experimental data pertaining to radiation detection.
- Familiarity with generic safety issues and their application.

Core academic skills

- The ability to and execute, under supervision, an experiment and to analyse critically the results and draw valid conclusions from them. Students should be able to evaluate the level of uncertainty in their results, understand the significance of uncertainty analysis and be able to compare these results with published data.
- The ability to deal with complex issues and communicate their conclusions clearly.

Personal and key skills

- The ability to communicate complex scientific ideas and the conclusions of an experiment concisely and accurately.
- The ability to manage their own learning and to make use of appropriate texts, research articles and other primary sources.
- Responsibility for personal and professional development.

SECTION D - COURSE STRUCTURE, CONTENT AND PATTERN OF DELIVERY

COURSE STRUCTURE

Full time students take the course over a one year period starting in September. Part-time students take the course over a two year period.

Full time students attend lectures and laboratory classes on Mondays and Thursdays during Semester 1 and Mondays, Tuesday and Thursday during Semester 2.

Students sit up to six examinations which take place in late May / early June, depending on the optional modules they have chosen, after which they undertake a summer dissertation project over three months. Satisfactory completion of both the examinations and project will lead to the award of the MSc degree in Radiation Detection and Instrumentation. Alternative exit awards also exist for students who perform less strongly in the May / June examinations, for example the Postgraduate Diploma in Radiation Detection and Instrumentation, or the Postgraduate Certificate in Radiation Physics, as described in Section E.

Start date of course
Week 1 of Semester 1, Monday 5 October 2009

Finish date of course
Summer vacation period, Friday 10 September 2010

Induction Week
During Induction Week the students will be introduced to the course by the Course Director. The student will receive instruction on safety procedures, use of the University library, register for computing and will be required to participate in a photograph session. Part time students are encouraged to attend activities during the Induction Week.

Coursework
Completion of all assessed course elements is compulsory. This includes laboratory work, computing coursework, and all examinations. Laboratory experiments must be formally written up and assessed for satisfactory completion of the course. (See Appendix A for details on report format).

Professional Placements
Professional placement does not form part of the course. However, placement in industry or a hospital is encouraged for dissertation work. It is the responsibility of the student to obtain such a placement, but informal support will be offered by members of the department to those students who wish to pursue this option. Students studying on other MSc Physics programmes have previously completed projects with some of the companies listed in Section I and Section G, for example. There is no financial support for any student undertaking an external project, except for those sponsored directly by industry.

COURSE CONTENT

The MSc course in Radiation Detection and Instrumentation comprises eight taught topics and one laboratory based topic, each of which is mandatory. There is also a tutorial topic and a number of industrial visits (typically two or three) are arranged during the course. Approximately 20% of the taught modules and 50% of the laboratory modules will be co-taught with the MSc in Radiation and Environmental Protection course.

The eight **modules** (and the associated contact hours) are:

Module 1: Radiation Physics (PHYM014, 30 credits) [30 hours lectures, 60 hours labs]
Includes the Radiation Laboratories
Module 2: Radiation Measurement (PHYM015, 15 credits) [30 hours]
Module 3: Detector Instrumentation (PHYM022, 15 credits) [30 hours]
Module 4: Imaging and Remote Sensing (PHYM023, 15 credits) [30 hours]
Module 5: Computer Interfacing and Modelling (PHYM024, 15 credits) [30 hours]
Modules 6/7: Applications of Radiation Detection (2x 15 credits) [2x 30 hours]
Students choose 2 modules from this list:
Option A: Particle Physics Detector Technology (taught at University of Sussex)
Option B: Astronomy Detector Technology (taught at University of Sussex)
Option C: Radiation Protection (PHYM018)
Option D: Medical Applications of Ionising Radiation (PHYM009)
Module 8: Research project and dissertation (60 credits) [407 hours]
(11 weeks @ 37 hrs per week)

A set of tutorials and industrial visits are given throughout the course to supplement and consolidate the taught material.

Credit weighting ascribed to the different modules

For **full time students**, the nominal credit weightings are arranged as follows:

Autumn Semester
Modules M1, M3, M5 (50%), equivalent to a student load of 52.5 credits

Spring Semester
Modules M2, M4, M5 (50%), M6, M7, equivalent to a student load of 67.5 credits
Summer Dissertation, 60 credits.

For **part time students**, the nominal credit weightings are arranged as follows:

Year 1 Autumn Semester
Modules M1, M5 (50%), equivalent to a student load of 37.5 credits

Year 1 Spring Semester
Modules M2, M4, M5 (10%), equivalent to a student load of 31.5 credits

Year 2 Autumn Semester
Modules M3, M5 (40%), equivalent to a student load of 21 credits

Year 2 Spring Semester
Modules M6, M7 equivalent to a student load of 30 credits
Summer dissertation, at end of either Year 1 or Year 2, 60 credits

Compulsory Modules
The following modules are compulsory for the award of Postgraduate Certificate in Radiation Physics and Postgraduate Diploma in Radiation Detection and Instrumentation:

- Module 1 (Radiation Physics, 30 credits)
- Module 2 (Radiation Detection, 15 credits)

Students achieving marks in the range 40-50% may be compensated for these modules, up to the normal maximum compensation limits, as outlined in Section E.

Delivery at the University of Sussex
Full details of the delivery of optional modules and/or the summer dissertation at the University of Sussex are listed in the RDI Memorandum of Agreement. A summary of the key facts are listed below:

RDI students will be registered at Surrey and subject to University of Surrey Ordinances and Regulations, and will only receive a degree award from the University of Surrey.

Students taking option modules at Sussex will register at Sussex for the individual modules, and will have access to Library and computing facilities at Sussex. Students will be subject to the Ordinances and Regulations of Sussex as regards any disciplinary matters and access to and use of University of Sussex property and resources (i.e. non-academic disciplinary matters).

Any complaints regarding individual modules shall be dealt with using the procedures of the institution who teaches that module. For disputes concerning the whole programme of study, or for academic appeals, the student will be subject to the regulations and procedures of Surrey.

Two 15-credit modules, delivered by the University of Sussex in the Spring Semester/Term, will be available to Surrey students as options, namely:

- Particle Physics Detector Technology
- Astronomy Detector Technology and Instrumentation

The modules will be available on Thursday (one AM, the other PM) and will run in accordance with the Sussex term dates i.e. the Sussex Spring term commences in early/mid January and runs for a 10 week block until Easter. Other Sussex students (year 4 undergraduates and postgraduates) may also take these modules as options.

The Sussex modules will be delivered by a mixture of class attendance at Sussex, and via video conferencing. Students should expect to travel to Sussex for a minimum of 7 weeks, with the remainder taught by video conference at Surrey.

A prerequisite of a Physics honours degree will normally be required for the two elective taught modules at Sussex. Students may choose one or both of the Sussex option modules, with students confirming their spring semester option selection in early November. Following consultation between Surrey and Sussex staff, final choices will be confirmed by the end of November. Provision of Sussex modules will be subject to final student numbers and will normally require a minimum of 5 students.

The research project (60-credits) will be a Surrey module but may be supervised and undertaken at Sussex (June- August) under the same prescriptions as any off-site Surrey project. A principal supervisor will be appointed at Sussex through normal Surrey procedures. A co-supervisor from Surrey will provide guidance on Surrey dissertation requirements. The Surrey External Examiner will moderate all projects to ensure parity and consistency of marking.

Surrey and Sussex have different pass marks (50/40% respectively) and levels for distinction (70/75%). A simple linear scaling algorithm will be applied to facilitate the handling of marks, as follows:

- For Sussex marks in the range 0% - 40%: Surrey % = 1.25 x (Sussex %)
- For Sussex marks in the range 40% - 100%: Surrey % = (0.833 x (Sussex %) + 16.67

A detailed list of scaled marks is shown overleaf.

The performance of Surrey candidates in the Sussex modules will be considered by the Sussex Physics and Astronomy Undergraduate Subject Examination Sub-Board in mid June. Any scaling of marks at this stage will be carried out using the procedure applied to all Sussex physics modules. The marks awarded will be sent to Surrey and translated using the linear algorithm before being submitted to the Surrey Postgraduate Board of Examiners. All Sussex marks will be subject to approval by the Sussex Physics and Astronomy Postgraduate Subject Examination Sub-Board which is held in September.

There is some variation in the handling of Academic Misconduct and Late Submission penalties at the two Universities, although both have an escalating penalty tariff that takes into account repeat offences across more than one module, up to and including course termination. Suspected cases of plagiarism will be considered under Surrey regulations. Penalties for late submission of assignments for option modules taken at Sussex will be assigned using the Sussex scheme to ensure parity with the mark adjusted accordingly for the piece of work.

Detailed table of Sussex/Surrey scaled marks:

Sussex %	Surrey %	Sussex %	Surrey %	Sussex %	Surrey %
0	0	40	50	70	75.0
1	1.3	41	50.8	71	75.8
2	2.5	42	51.7	72	76.6
3	3.8	43	52.5	73	77.5
4	5.0	44	53.3	74	78.3
5	6.3	45	54.2	75	79.1
6	7.5	46	55.0	76	80
7	8.8	47	55.8	77	80.8
8	10	48	56.7	78	81.6
9	11.3	49	57.5	79	82.5
10	12.5	50	58.3	80	83.3
11	13.8	51	59.2	81	84.1
12	15.0	52	60	82	85.0
13	16.3	53	60.8	83	85.8
14	17.5	54	61.6	84	86.6
15	18.8	55	62.5	85	87.5
16	20	56	63.3	86	88.3
17	21.3	57	64.1	87	89.1
18	22.5	58	65.0	88	90
19	23.8	59	65.8	89	90.8
20	25.0	60	66.6	90	91.6
21	26.3	61	67.5	91	92.5
22	27.5	62	68.3	92	93.3
23	28.8	63	69.1	93	94.1
24	30	64	70	94	95.0
25	31.3	65	70.8	95	95.8
26	32.5	66	71.6	96	96.6
27	33.8	67	72.5	97	97.5
28	35.0	68	73.3	98	98.3
29	36.3	69	74.1	99	99.1
30	37.5	70	75.0	100	100
31	38.8				
32	40				
33	41.3				
34	42.5				
35	43.8				
36	45.0				
37	46.3				
38	47.5				
39	48.8				
40	50				

PATTERN OF DELIVERY

The course is offered for either full-time or part-time study.

FULL-TIME STUDENTS

Full-time students study for 1 year. All formal teaching is held on two days per week - Mondays and Thursdays. Students can either live on campus, or can attend the University 2 days per week.

The summer project is full-time, with hours to be arranged in discussion the project supervisor. The project can be carried out at either Surrey or Sussex Universities, or at the student's sponsoring company.

The diagram below gives an overview of the structure of the complete course.

Autumn Semester

Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		**12**	**13**	**14**	**15**
Monday 9-10	M5 Computer Interfacing and Modelling											Christmas Vacation	M5 CI & M			
Monday 10-1	M1 Radiation Physics												M1 Rad Phys			
Monday 2-5	M1 Statistics			M1 Laboratory									M1 Laboratory			
Thursday 10-1	M3 Detector Instrumentation												Options			
Thursday 2-5	M1 Laboratory												Options			

Spring Semester

Week	**1**	**2**	**3**	**4**	**5**	**6**	**7**		**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Monday 9-10	M5 CI & M					M5 Proj.		Easter Vacation	M5 Project					Revision	Exams	
Monday 10-1		M2 Radiation Measurement							M2 Radiation Meas.							
Monday 2-5	M4 Imaging and Remote Sensing								M4 Imag. & Rem. Sens.							
Thursday 10-1	Options								Options							
Thursday 2-5	Options								Options							

Summer Research Project

	July – September (11weeks)
Full time	Research project at Surrey/Sussex, or at the student's employer

PART-TIME STUDENTS

Part-time students attend the University 1 day per week, for two years. In the first year teaching is on Mondays, and in the second year on Thursdays.

Year One

Modules 1, 2 and 4, plus the computing elements of Module 5 are completed in Year 1.

Exams Papers for Modules 1, 2, and 4 are sat in May of the first year

Year Two

Module 3, the Group Project for Module 5, plus two of Options A-D are completed in Year 2

Exam Papers for Module 3, plus examinations for Options C and D, are sat in May of the second year (Options A and B are 100% coursework).

Dissertation (Module 8) can be carried out during the summer of either Year 1 or Year 2, with submission no later than the 2nd week of September in Year 2.

Laboratory Work (Module 1)

In Year 1 part-time students attend the laboratory on Monday afternoons in the Autumn semester and carry out five experiments. The remaining five experiments should be completed either during the summer of Year 1 or during Thursday afternoon laboratory sessions in the Autumn semester of Year 2.

Part-time students must submit a total of five Laboratory Reports. The first two reports should be submitted by week 7 (Friday 20 November 2009) to allow constructive feedback and to ensure that the Laboratory Reports are of the required standard. At least one more Laboratory Report should be submitted before the end of the Spring semester in Year 1. The remaining two reports must be submitted by the end of the Autumn semester in Year 2.

Design Project (Module 5) is carried out by part-time students in the Autumn semester of Year 2. The written report is submitted at the start of the Spring semester, and an oral presentation will be given in February.

SECTION E – REGULATIONS AND ASSESSMENT

Regulations for students pursuing modular programmes of study for higher awards in the Department of Physics

These Regulations should be read together with the *General Regulations for Higher Awards of the University for Students Pursuing Programmes on a Modular Basis* and also the *Regulations for Boards of Examiners*. This and other regulatory guidance is published in the University Calendar (available at the website http://portal.surrey.ac.uk/calendar/generalregs/index.jsp). An authoritative interpretation of these regulations will be made by the Postgraduate Board of Examiners of the Department of Physics.

1. Terminology

1.1 An AWARD is a recognised qualification of the University of Surrey. The higher awards that may follow from the modular Programmes of Study in the Department of Physics described in these regulations are the following:

Postgraduate Certificate	PGCert
Postgraduate Diploma	PGDip
Master of Science	MSc

The name of the award may indicate a specialisation appropriate to the programme of study.

1.2 The PROGRAMME OF STUDY is the full or part-time modular programme of the Department of Physics for which the student is registered. A student may be registered for one of the following modular programmes:

PGCert	Radiation Physics
PGDip	Radiation and Environmental Protection
PGDip	Medical Physics
PGDip	Radiation Detection and Instrumentation
MSc	Radiation and Environmental Protection
MSc	Medical Physics
MSc	Radiation Detection and Instrumentation
MSc	Physics (EuroMasters)

1.3 A MODULE is an assessed unit of learning (e.g. a lecture or laboratory based activity) in the programme of study. Masters level modules are normally valued at 15 credits.

1.4 A MULTIPLE MODULE is an assessed unit of learning in the programme of study with a credit value that is an integer multiple of that for an individual module.

1.5 The LEVEL is the academic standard of modules or multiple modules. All modules in the programmes of study covered by these higher awards regulations are Masters Level, Level M.

1.6 CREDITS are awarded upon the successful completion of modules or multiple modules. Credits are awarded at the level of the module. The credit value of modules or multiple modules is in proportion to the expected workload of the modules or multiple modules, 15 credits being equivalent to a notional study period of approximately 150 hours.

2. Registration

2.1 On entry to the Department of Physics, all students must register for one of the programmes of study named in 1.2 above. Students registering for the Physics (EuroMasters) programme of study may be admitted to the programme with accredited prior learning (APL) of 120 credits at Level M, based on taught modules and multiple modules from programmes at Surrey and elsewhere. In the case of credit gained on non-Surrey Masters Programmes, the credits for the modules, but not the marks awarded, will be used in consideration of candidates for a University of Surrey award, in accordance with General Regulation 3.7.

2.2 The prescribed taught and project/dissertation modules and multiple modules that contribute to each programme of study are given in the tables in the relevant postgraduate Programme Handbooks. If a choice of modules is available within a given programme of study, it is the student's responsibility to ensure that the modules for which they register are consistent with those specified for the chosen programme of study.

2.3 Registration for modules or multiple modules also registers the student for assessment in those modules or multiple modules.

2.4 The Department of Physics reserves the right to cancel modules, to introduce new modules, or, exceptionally, to limit or select students for enrolment on modules.

2.5 Persistent absence from any classes without good cause may result in the student receiving a formal written warning and may lead to subsequent course termination. Students should refer to the Programme Handbooks for guidance on the Department's expectations of attendance.

2.6 Students registered for a programme of study which includes periods of professional experience and/or placements for research leading to a dissertation are required at all times, and as a condition of continued registration for that programme, to behave in a manner as stipulated by University General Regulation 4.14. The University reserves unconditionally the right to exclude or withdraw a student from a professional experience or placement without notice on the grounds of unprofessional behaviour, professional misconduct, and/or if it believes that the student's behaviour has the potential to cause harm to others or him or herself. General Regulations covering *Fitness to Practice* can be found in the *General Regulations Governing Fitness to Practice* section of the University Calendar. This can be found at http://portal.surrey.ac.uk/calendar/generalregs/11fitnesstopractise.jsp

3. Programme Administration

3.1 The Combined Postgraduate Board of Studies of the Department of Physics is responsible for advising the Dean of the Faculty, through the postgraduate taught Course Directors, on the overall design, administration, monitoring and development of the programmes of study within the Department of Physics.

3.2 There shall be a named Course Director for each named programme of study with responsibility for the day-to-day running of the named programme of study and for submitting any changes in the programme for approval to the Combined Postgraduate Board of Studies.

3.3 There will be named Module Co-ordinator(s) for each module, normally being the lecturer(s) responsible. These responsibilities include co-ordinating the teaching and assessment for the module and the timely reporting of the results of assessments to the Examinations Officer.

3.4 Each student will be allocated a personal tutor who, together with the Course Director of the programme of study, may offer advice on the programme of study, where appropriate.

4. Board of Examiners

4.1 Membership of the Postgraduate Board of Examiners will consist of all members of the Academic Staff of the Department of Physics, all module lecturers and External Examiner(s).

4.2 There will be meetings of the Postgraduate Board of Examiners to consider the results of assessments of modules and multiple modules (examinations, coursework, project work and dissertations).

4.3 A candidate whose performance in assessments or examinations has been, or is likely to be impaired because of ill health or other extenuating circumstances, must inform the Dean of the Faculty (via the appropriate Course Director and Examinations Officer) in writing at the earliest opportunity and provide supporting documentary evidence. Guidance is provided in *Guidance for Students on Mitigating Circumstances In Relation To Examinations and Other Forms of Assessment* (http://portal.surrey.ac.uk/calendar/acstan/scvii/index-04.jsp), Appendix VII D of the University Calendar) and in the Programme Handbooks. In such cases the Chair of the Board of Examiners will inform the Board who will then give due consideration to the matter when making their recommendations.

4.4 The Postgraduate Board of Examiners will report its recommendations to the Senate Progression and Conferment Executive (SPACE), the University committee responsible for confirmation of student progress and awards.

5. Grading of Assessments and Progression

5.1 Modules and multiple modules will normally be assessed by a combination of coursework, examination and dissertation, as described in the appropriate Programme Handbooks.

5.2 Coursework submitted later than its published submission deadline will normally incur a penalty on the mark awarded. This penalty will be 7% if the work is submitted within one day of the stated deadline, plus 7% for each additional day up to a maximum of five working days subsequent to the stated deadline (35% penalty). Coursework will not normally be accepted more than one week after a stated deadline. Units of assessment that are failed as a result of non-submitted coursework assessments or non-attendance at examinations will be awarded a mark of 0% for those units of assessment.

5.3 The University treats plagiarism very seriously and any student found guilty of committing plagiarism, misrepresentation of responsibility for individual coursework, or of undue collusion on assessed coursework will be subject to the penalties set out in the regulations for the *Conduct of Examinations and other Forms of Assessment* (University Calendar Section C, http://portal.surrey.ac.uk/calendar/generalregs/14conductofexaminations.jsp).

5.4 Units of assessment in modules or multiple modules that are assessed by examination will normally be examined during the main University examination periods.

5.5 A student will be deemed to have passed modules or multiple modules if the mark obtained is equal to or exceeds 50% and will then be awarded the credits appropriate to those modules or multiple modules.

5.6 A student will be deemed to have failed modules or multiple modules if the mark obtained is less than 50% and, except as allowed by regulations 5.7, 5.8 and 5.9, will not be awarded credits for the modules or multiple modules.

5.7 A student achieving an overall aggregate mark for the programme of study equal to or in excess of 50% but failing one or more modules may be eligible for compensation credits, in accordance with University General Regulation 4.3. To be considered for compensation a student must first achieve:

45 credits (Postgraduate Certificate programme),
90 credits (Postgraduate Diploma programmes),
90 taught module credits, plus a mark for the dissertation multiple module equal to or in excess of 50% (Master of Science programmes).

5.8 For failed modules or multiple modules to be eligible for compensation as described in regulation 5.7 a student must normally have achieved a mark greater than or equal to 40% in these failed modules. However, if the student's overall aggregate mark is equal to or greater than 60% then failed modules where a mark greater than or equal to 35% has been achieved may be eligible for compensation (see University General Regulation 4.3).

5.9 A maximum of 30 credits (15 credits for the Postgraduate Certificate programme) may be awarded as compensation credits, at the discretion of the Board of Examiners, where such compensation would qualify the student to be considered for an award of the University. All taught modules in the programmes of study are eligible for compensation. Compensation credits are not offered for the dissertation multiple modules.

5.10 A student failing a module or multiple module and awarded compensation credits by a Board of Examiners shall have the right to decline the compensation credits and seek re-assessment in the failed units of assessment of the failed modules. A student wishing to exercise this right must inform the Chairman of the Board of Examiners in writing, normally within one week of the meeting of the Board of Examiners at which the compensation credits were awarded.

5.11 The marks awarded for compensated modules remain at the level gained in the failed module(s).

5.12 Following completion of assessments on a Programme of Study, a student who fails to obtain sufficient credits for an award of the University will normally have their programme of study suspended.

5.13 A student whose programme of study is suspended will be allowed one further attempt to gain pass marks and credits (or compensation credits) for the failed module(s) or multiple module according to regulations 5.5, 5.7, 5.8 and 5.9. This will normally be at the next available assessment opportunity.

5.14 A student whose programme of study may be suspended under regulation 5.12 may have their programme of study terminated in cases where a prior formal written warning has been issued by the Dean of the Faculty or the Course Director (see Regulation 2.5).

5.15 Subject to the agreement of the Course Director and the Head of Department, and upon payment of the appropriate fees, a student whose programme of study has been suspended may, exceptionally, be permitted to retake an agreed fraction of the taught modules or units of assessment for the programme of study.

5.16 A student seeking reassessment in the failed units of assessment of failed modules or multiple modules will normally re-submit all coursework and/or resit any failed examinations at the earliest opportunity offered by the Department. The reassessment will follow the assessment arrangements as validated for a particular module.

5.17 When a student repeats unit(s) of assessment of a failed module and subsequently passes the module, the penalised mark awarded for each re-assessed unit of assessment shall be the actual mark obtained or the arithmetic mean of the actual mark and the pass mark, whichever is the lower. The module mark will be adjusted accordingly. If the student fails the module on reassessment the fail mark stands and is not adjusted.

The actual mark used in the above will be the better of the marks achieved from either the first or second attempt at the unit of assessment.

If the adjusted module mark is below the pass mark but a student would have passed the module without applying the penalty for the unit(s) of assessment, the minimum pass mark will be recorded for that module.

The mark recorded on the student's transcript shall be the adjusted mark awarded by the Board of Examiners.

5.18 A student who, following reassessment, fails to gain the required credits for the target award on their programme of study, will normally have their programme of study terminated.

5.19 A student who permanently withdraws, or has had their programme of study terminated, but who satisfies the module and credit requirements (including those of General Regulation 5.7) for an alternative award of the University will normally be eligible to be considered for the alternative award.

6. Regulations for the award of Postgraduate Certificate and Postgraduate Diploma

6.1 The following Postgraduate Certificate qualification may be awarded to eligible candidates:

PGCert	Radiation Physics

The Postgraduate Certificate will be awarded without classification.

The following Postgraduate Diploma qualifications may be awarded to eligible candidates:

PGDip	Radiation and Environmental Protection
PGDip	Medical Physics
PGDip	Radiation Detection and Instrumentation

Classes of Postgraduate Diploma awards will be with *Distinction* (70%), *Merit* (60%) or *Award* (50%) according to the class mark boundaries indicated.

6.2 A student registered on the Radiation Physics, Radiation and Environmental Protection or the Radiation Detection and Instrumentation programmes, or who has elected to follow the taught components of these programmes as part of the MSc Physics (EuroMasters) programme, who has been awarded 60 credits at level M, and has completed their programme of study [or by reason of permanent withdrawal or course termination does not continue on their programme and does not satisfy the requirements for any higher award] may be awarded the Postgraduate Certificate in

Radiation Physics in accordance with regulation 6.1. The 60 credit requirement for the Postgraduate Certificate award must include those compulsory modules and multiple modules as prescribed in the Radiation and Environmental Protection and Radiation Detection and Instrumentation programme handbooks.

6.3 A student who has been awarded 120 credits at Level M and has completed their programme of study [or by reason of permanent withdrawal or course termination does not continue on their programme and does not satisfy the requirements for any higher award] may be awarded the Postgraduate Diploma in accordance with regulation 6.1. Where a student elects to withdraw from the MSc Physics (EuroMasters) programme, the student will be awarded one of the named Postgraduate Diploma qualifications in 6.1 in accordance with the taught component they have followed. The 120 credit requirement for the Postgraduate Diploma must include credits for those compulsory modules and multiple modules as prescribed in the programme handbooks. The remainder of the credit requirement may comprise credits gained on both taught modules and the dissertation multiple modules.

If a candidate has gained credits at Level M with a value of greater than 120 credits then, having first satisfied the credit requirements from the compulsory modules, the candidate's Postgraduate Diploma mark will be computed from those remaining modules (up to the requirement of 120 credits) with the highest marks.

In determining the class of Diploma, *Distinction*, *Merit* or *Award*, reference will be to both:

(i) The student's overall aggregate mark, and
(ii) To the number of credits in a class, General Regulation 7.5, as follows:
At least 75 credits at level M at or higher than the indicative class, provided that:

- The overall weighted aggregate mark is at least at the mid point of the class below the indicative class, and
- No more than 30 credits fall within a division two or more below the indicative division

The classification will be the one that, having considered methods (i) and (ii) above, gives the most beneficial outcome to the candidate.

7. Regulations for the award of Master of Science

7.1 The following Master of Science degrees may be conferred on eligible candidates:

MSc	Radiation and Environmental Protection
MSc	Medical Physics
MSc	Radiation Detection and Instrumentation
MSc	Physics (EuroMasters)

Classes of degree will be with *Distinction* (70%), *Merit* (60%) or *Award* (50%) according to the class mark boundaries indicated.

7.2 A student who has been awarded 180 credits at Level M (240 credits in the case of the MSc Physics (EuroMasters) programme) and has completed their programme of study may be conferred the degree of Master of Science in accordance with regulation 7.1.

In determining the class of Degree, *Distinction*, *Merit* or *Award*, reference will be to both:

(i) the student's overall aggregate mark, and
(ii) to the number of credits in a class, General Regulation 7.5.

The latter rule is as follows for those Masters awards based on a 180 credit requirement:

At least 105 credits at level M (excluding any level HE3 modules) at or higher than the indicative class, provided that:

- The overall weighted aggregate mark is at least at the mid point of the class below the indicative class, and
- No more than 30 credits fall within a division two or more below the indicative division

and as follows for candidates for the MSc Physics (EuroMasters) programme:

At least 150 credits at level M (excluding any level HE3 modules) at or higher than the indicative class, provided that:

- The overall weighted aggregate mark is at least at the mid point of the class below the indicative class, and
- No more than 60 credits fall within a division two or more below the indicative division

The classification will be the one that, having considered methods (i) and (ii) above, gives the most beneficial outcome to the candidate.

8. Appeals Procedure

Procedures for dealing with student appeals arising from examination and assessment procedures or from decisions arising from these procedures are set out in Section 9 of the University General Regulations (see http://portal.surrey.ac.uk/calendar/generalregs/index.jsp).

9. Accuracy and Programme Modifications

Every effort has been made to ensure the accuracy of the information concerning the programme(s) of study contained in the Programme Handbooks and in these Programme Regulations. The Department of Physics and the University of Surrey reserves the right to introduce changes to the information given, including the addition, withdrawal or restructuring of programmes of study.

Written: July 2007 (approved)
Revised: January 2008 (approved)
Revised: June 2008 (approved)
Revised: January 2009 (approved)
Revised: July 2009

SECTION F – FULL MODULE DESCRIPTIONS

Module 1: Radiation Physics

Module Provider:	Physics	**Module Code:**	PHYM014
Level:	M	**Number of Credits:**	30
Module Co-ordinator:	Dr Zsolt Podolyak		

Module Availability
Autumn Semester

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark (%)**
Closed book examination	50 %
Coursework	50%
Part-time Students:	Same as for full time students
Qualifying Condition(s)	None

Pre-requisite/Co-requisites

None

Module Overview

Lectures provide a detailed and systematic overview of atomic and nuclear physics and the interaction of radiation with matter, plus introductory material describing detector operation and dosimetry.
Laboratory sessions are designed to provide the student with practical experience in handling radioactive substances, detectors and instrumentation.

Module Aims

To provide the student with a detailed understanding of the structure of matter, radioactivity, types of radiation and the mechanisms by which radiation interacts with matter.
To provide the student with the comprehensive understanding of the experimental use of radioactive materials, radiation counting, spectroscopy equipment, dosimetry measurements and standard radiation experimental techniques.

Learning Outcomes

After completing this module, the student should be able to:-

Module Specific Skills:
- Systematic understanding of the fundamental processes involved with the interaction of X- and gamma-ray photons, charged particles and neutrons with matter
- Critical analysis and self-directed problem solving of the practical aspects of handling radioactive substances and the ability to extract qualitative and quantitative information about the emitted radiations
- Understand basic evaluation of experimental data using standard statistical methods

Discipline Specific Skills:
- Confidence in handling radioactive materials
- Application of statistical analysis techniques to specialised radiometric data through appropriate software tools
- Application of skills in an experimental context for the measurement for various radiation emissions in terms of both dosimetry and spectroscopy
- Perform a detailed investigation of radiation sources and their interactions in media

Personal and Key Skills:
- Maintain a laboratory diary at a level appropriate of a professional scientist
- Critically analyse and summarise data

- Provide concise and accurate reporting of findings, including limitations resulting from an appreciation of equipment capability and the availability of calibration standards

Module Content

Lecturer	Title	Lecture Hours	Lab Hours
Dr D A Bradley	Atomic physics: Bohr model, Pauli Exclusion Principle, de Broglie hypothesis, Heisenberg Uncertainty Principle, electronic structure of atom, x-ray spectra; Moseley's law, x-ray fluorescence and x-ray fluorescence yield, Auger electrons. Experimental evidence for size of nucleus; Rutherford scattering, nuclear systematics, nuclear binding energy. Systematic study of nuclear binding energy: Von Weizsäcker Semi-Empirical Mass Formula and Liquid Drop Model, beta decay, energy released during fission of heavy nuclei; Shell Model, Woods-Saxon potential, spin-orbit interaction, Collective-Shell Model. Optical model. Theory of alpha and beta decay; Geiger-Nuttall Law, electron capture. Gamma emissions. Coulomb scattering. Nuclear reactions and kinematics. Breit-Wigner Formula. Fission. Radioactive decay through a chain. Production of radionuclides.	18	
Dr Z Podolyak	Interactions of radiation with matter, photons, neutrons and charged particles. Attenuation coefficients and the Mixture Rule. Concept of neutron flux and cross-section; the neutron spectrum. The interaction of electrons (and other charged particles) with matter; elastic and inelastic processes, bremsstrahlung and radiative yield, energy dependence. Measurement of radioactivity and standards. Introduction to radiation detectors, describing the basic function and operation of semiconductor, scintillator and gas detectors, counting statistics, dead time and energy resolution.	9	
Prof P H Regan	Introduction to dosimetry measurements, air ionisation chambers, use of absolute standards, calculation of exposure, absorbed dose, and dose rate. Basic biological effects of radiation.	3	
Prof P H Regan Prof W N Catford Dr P J Sellin Dr Z Podolyak	Radiation Laboratory experiments. Laboratory demonstrations and safety instruction Scripted experiments that students undertake in pairs, one per week. Students undertake 10 one week experiments selected from a range of possible topics.		60
Prof B M Murdin	General Laboratory skills. In particular basic statistical analysis, error analysis, errors on the mean, weighted means, binomial, normal and Poisson distributions, least squares fitting.	10	

Methods of Teaching/Learning

Selected Texts/Journals

1. “Nuclear & Particle Physics”, Blin-Stoyle, R.J., Chapman & Hall (ISBN 0-412-38320-9)
2. “Nuclear Physics: Principles and Applications”, Lilley, J., John Wiley & Sons, 2001 ISBN 0-471-97935)
3. Radiation Laboratory manuals, University of Surrey
4. “Radiation Detection and Measurement”, Knoll, G.F., John Wiley & Sons, 1999 Practical Radiation Monitoring, Measurement Good Practice Guide, The NPL, 2002. ISSN 1368-6550
5. “Introduction to Radiological Physics and Radiation Dosimetry”, Frank Herber Attix, Wiley-Interscience Publication, 1986 New York
6. “Introductory Nuclear Physics”, Krane, K.S., John Wiley & Sons, 1988 New York
7. ‘’Introduction to Health Physics, fourth edition’’, Herman Cember and Thomas E. Johnson, ISBN 978-0-07-142308-3

Methods of Assessment

This module is assessed in three separate units of assessment: 50% of the marks of the 30 module credits are awarded for Paper 1 which will consist of 6 questions from which students answer 4 questions from 6.

The remaining 50% of the module marks will come from (a) the assessment of 5 marked laboratory experimental reports from work carried out in the radiation laboratory which make up 40% of the total module mark; and (b) a class test on the statistics and related laboratory skills which will make up 10% of the final module mark.

Module 2: Radiation Measurement

Module Provider:	Physics	**Module Code:**	PHYM015
Level:	M	**Number of Credits:**	15
Module Co-ordinator:	Prof Wilton Catford		

Module Availability
Spring Semester

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark (%)**
Closed book examination	100 %
Part-time Students:	Same as for full time students
Qualifying Condition(s)	None

Pre-requisite/Co-requisites

None

Module Overview

These lectures describe in detail the principles of radiation detection, measurement and dosimetry.

Module Aims

This course will give the student a detailed understanding of the physical/chemical principles underlying the operation of a wide range of techniques for detection/dosimetry of ionising radiation enabling him/her to make appropriate choices of instrumentation in practical situations.

Learning Outcomes

After completing this module, the student will have acquired the following:

Module Specific Skills:
- Comprehensive understanding of the role of fundamental processes involved with the interaction of X- and gamma-ray photons, charged particles and neutrons with matter
- Planning and implementation of the critical aspects of radiation detection and shielding
- Critical analysis of dose calculations and assessments from specific radiation sources
- Detailed knowledge of the principles of operation of solid state semi-conductor detectors, scintillation counters, gas ionization detectors

Discipline Specific Skills:
- Confidence in handling radiation monitors/detectors and dosemeters
- Critical awareness of the selection and application of radiation detectors for different types of radiation measurement and in what environments
- Select appropriate means of measurement for the various radiation emissions in terms of both dosimetry and spectroscopy
- Carry through a detailed investigation of radiation sources and their interactions

Personal and Key Skills:
- Critical analysis and ability to summarise original dosimetry data
- Comprehensive understanding of the methods required to calculate dose and radiation effects

Module Content

Lecturer	Title	Lecture Hours	Lab Hours
Prof W N Catford	Principles of radiation counting and review of nuclear electronics for selection, recording and analysis of detector outputs. Action of gas filled ionisation chamber and proportional counters, gas multiplication; ion mobility, recombination, pulsed and direct current modes of operation; Geiger-Muller counter, internal and external quenching, practical devices. Scintillation counting with gases, liquids and solids; theory of operation, selection for various applications. Solid state detectors; semiconductor counters, surface barrier detectors, Si(Li), Ge(Li) and hyper-pure Ge.	15	
Prof P H Regan	Thermoluminescent dosimetry, radio-photoluminescence. Relation between detection and dosimetry; concept of exposure, the Roentgen, air-kerma, exposure measurements with free air chamber. Absorbed dose, dose equivalent, Gray, Sievert, quality factor, radiation and tissue weighting factors, build-up factors, charged particle equilibrium, Bragg-Gray cavity principle, cavity chambers. Primary and secondary dosemeters, calorimetry, chemical dosimetry, gas dosimetry, W-values, stopping power ratio, matching to medium, air and tissue equivalence, interface effects.	12	
Prof N M Spyrou	The activation equation and 1/v absorbers. Source standardisation and radiation spectroscopy. Neutron detection and dosimetry, mixed field dosimetry, fission track detectors, and neutron spectrometry.	3	

Methods of Teaching/Learning

Selected Texts/Journals

1. “Radiation Detection and Measurement”, Knoll, G.F., John Wiley & Sons, 1999
2. “Introduction to Radiological Physics and Radiation Dosimetry”, Frank Herber Attix, Wiley-Interscience Publication, 1986 New York
3. “Nuclear Physics: Principles and Applications”, Lilley, J., John Wiley & Sons, 2001 (ISBN 0-471-97935)
4. “Fundamentals of Radiation Dosimetry”, Greening, Hilger 1985 (Medical Physics Handbooks 15)
5. “Radiological Risk, Assessment and Environmental Analysis”, Till and Grogan, (ISBN: 978-019-51272), Oxford University Press
6. “Introduction to Health Physics”, Herman Cember (ISBN: 0-07-105461-8), McGraw-Hill
7. “Radioactive Fallout After Nuclear Explosions and Accidents (Radioactivity in the Environment)”, Iurii Izrae, (ISBN: 0-08-043855-5), Elsevier Science
8. “Radiation Protection in the Health Sciences”, (ISBN: 978-981-270-5), World Scientific Publishing
9. “Introduction to Radiation Protection Dosimetry”, (ISBN: 978-981-02-21), World Scientific Publishing

Methods of Assessment

This module is assessed in Paper II which will consist of 6 questions. Students answer 4 questions from the 6. Full marks for 4 questions will be equivalent to 100 % of the total marks available in assessment of this module.

Module 3: Detector Instrumentation

Module Provider:	Physics	**Module Code:**	PHYM022
Level:	M	**Number of Credits:**	15
Module Co-ordinator:	Dr Paul Sellin		

Module Availability
Autumn Semester

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark (%)**
Closed book examination	100 %
Part-time Students:	Same as for full time students
Qualifying Condition(s)	

Pre-requisite/Co-requisites

None

Module Overview

An in-depth discussion of detector instrumentation will be covered, designed to complement experiments in the Autumn semester laboratory classes. Topics will include the performance and use of preamplifiers, spectroscopy systems and multi-channel analysers (MCAs). Digital methods for data acquisition, including digital pulse processing, pulse shape discrimination and digital MCA systems. Instrumentation for scintillators and gas detectors, including the lasted developments in Si-PMT and GEM devices. The 2nd part of the module will cover digital signal processing and the role of noise in affecting detector performance, including Fano-limited noise, electronic noise and leakage current. Examples of current CMOS readout circuitry, ASIC designs and pixel detectors will be discussed.

Module Aims

This module explores the theory of operation and practical aspects of instrumentation for radiation detection, covering both traditional analogue instrumentation techniques plus the latest developments in digital pulse processing. Students will also critically evaluate the role of statistical processes in detector noise and electronic signal processing.

Learning Outcomes

After completing this module, the student will have acquired the following:

Module Specific Skills:

- A detailed understanding of the instrumentation chain used for the readout of semiconductor, scintillation and gas detectors
- A critical analysis of noise processes in detectors, with the influence of noise on detector performance.
- A knowledge of the functionality and system architecture of ASICs and pixel detectors at the forefront of current research.

Discipline Specific Skills:

- Technical expertise in handling radiation detectors, and applying a fundamental understanding of their operation to optimise detector performance.
- Ability to select the appropriate instrumentation chain for a given application.

Personal and Key Skills:

- Critical analysis and understanding of instrumentation and detector performance for a given experimental setup.

Module Content

Lecturer	Title	Lecture Hours	Lab Hours
Dr P J Sellin	Detector Instrumentation for Spectroscopy: Charge sensitive preamplifiers, spectroscopy amplifiers, shaping and filters, energy resolution. Analogue signal processing: Multi-channel analysers, discriminators, logic pulses and timing measurements, TACs. Digital pulse shape analysis and applications to n/γ discrimination. Scintillator and gas detector instrumentation: the photomultiplier tube and APD, DC ion chambers, GM tubes and survey meters. Silicon detector systems for particle tracking, minimum ionising particle detection, drift detectors and position sensitive detectors. Large scale HEP detector – the ATLAS inner tracker.	15	
Mr P Seller (RAL)	Digital signal processing: waveform digitisers, filtering, sampling theory. Applications of commercial digital pulse processors. Electronic noise in detector circuits: Poisson statistics, Fano-limited noise, noise power spectrum and Fourier analysis. Instrumentation for Physics applications: ASIC functionality for imaging and strip detectors. Photon counting architecture and active pixel sensors.	15	

Methods of Teaching/Learning

Selected Texts/Journals

1. "Radiation Detection and Measurement", Knoll G.F., Edition 3 1999
2. "Semiconductor Radiation Detectors", Lutz, G., Springer 1999
3. "Introductory Nuclear Physics", Krane K.S., Wiley
4. "Nuclear Physics Principles and Applications", Lilley, J., Wiley
5. "Semiconductors for Room Temperature Nuclear Detector Applications, Volume 43 of Semiconductors and Semimetals, Ed. Schlesinger, T.E. and James, R.B., Academic Press 1995
6. "Physics of Semiconductor Devices", Sze, S.M. and Kwok, K.N., Wiley Interscience, Edition 3 2007
7. "Semiconductor Detector Systems" by Helmuth Spieler
8. "Introductory Digital Processing, second edition" by Paul A. Lynn and Wolfgang Fuerst

Methods of Assessment

This module is assessed in Paper 3 which will consist of 6 questions. Students answer 4 questions from the 6.

Module 4: Imaging and Remote Sensing

Module Provider:	Physics	**Module Code:**	PHYM023
Level:	M	**Number of Credits:**	15
Module Co-ordinator:	Dr Paul Sellin		

Module Availability
Spring Semester

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark (%)**
Closed book examination	100 %
Part-time Students:	Same as for full time students
Qualifying Condition(s)	

Pre-requisite/Co-requisites

None

Module Overview

This course describes the concepts behind Radiation Imaging and Remote Sensing, both in term of the various types of detectors used for radiation imaging, and their application to radiation monitoring and sensing. Both semiconductor and scintillators imaging detectors will be described, including the latest developments in silicon pixel detectors and CMOS pixellated devices. Imaging theory will also be reviewed, including Modulation Transfer Function and Detector Quantum Efficiency. The application of detectors for radiation imaging will be described, including Compton scatter telescopes, coded-aperture cameras and collimated detectors. The application of imaging will be explored in terms of remote sensing, with a particular emphasis on environmental measurements and security imaging.

Module Aims

This module will provide the student with a more detailed understanding of the operation and performance of various semiconductor and scintillator-based imaging detectors, including silicon pixel detectors, CMOS sensors, scintillators-based cameras and neutron imaging detectors. The module will explore quantitative methods for assessing imaging detector performance, and will discuss the use of imaging and remote sensing detectors for various applications, including security imaging, remote monitoring, and environmental measurements.

Learning Outcomes

After completing this module, the student will have acquired the following:

Module Specific Skills:

- An in-depth understanding of the performance and operation of a range of semiconductor and scintillation imaging detectors.
- Critical application of methods for quantitative analysis of imaging detectors and data.
- Detailed knowledge of the application of imaging and remote-sensing detectors to a variety of applications including environmental monitoring and security imaging.

Module Content

Lecturer	Title	Lecture Hours	Lab Hours
Dr D A Bradley	Semiconductor imaging detectors: Hybrid pixel, TFT, deep-depletion ccd Scintillator imaging detectors: CCD/cmos with phosphors, thick film scintillators (columnar CsI), scintillating fibres X-ray imaging and CT: X-ray transmission imaging and CT reconstruction, X-ray scatter techniques, phase contrast imaging, and energy resolved/spectroscopic techniques. Use of synchrotron beams. Analysis of image data: DQE, MTF etc.	9	
Dr James Parkin (Lab Impex Ltd)	Environmental and Remote Sensing detector systems Lab-based low background counting systems Field measurements: detectors and instrumentation for environmental and low background measurements	6	
Dr I Jupp (DSTL)	Applications in security imaging (1): Compton cameras – principles of operation Coded Aperture imagers Backscatter and pinhole imaging	3	
Dr W Gilboy	Neutron detection and imaging detectors: BF3 and He3 tubes, boron and lithium loaded scintillators, neutron imaging.	6	
Dr P Burgess (Nuvia Ltd)	Overview of Electronic Personal Dosmiter (EPD) Design philosophy and operation Performance for alpha, beta, gamma dosimetry Neutron detection	3	
Dr P J Sellin	Applications in security imaging (2) Detection of hidden sources and isotope identification Active interrogation techniques: pulse neutron/gamma irradiation, high energy X-ray sources	3	

Methods of Teaching/Learning

Selected Texts/Journals

1. “Radiation Detection and Measurement”, Knoll G.F., Edition 3 1999
2. “Semiconductor Radiation Detectors”, Lutz, G., Springer 1999
3. “The Physics of Medical Imaging”, Ed. Webb, S., IoPP, 2002
4. “The Essential Physics of Medical Imaging”, Ed. Bushberg, J.T., Williams and Wilkins, 1994
5. “Physics in Nuclear Medecine”, Cherry, Sorenson and Phelps, Saunders Edition 3, 2003

Methods of Assessment

This module is assessed in Paper 4 which will consist of 6 questions. Students answer 4 questions from the 6.

Module 5: Computer Interfacing and Modelling

Module Provider:	Physics	**Module Code:**	PHYM024
Level:	M	**Number of Credits:**	15
Module Co-ordinator:	Dr Paul Sellin		

Module Availability
Autumn and Spring semesters

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark (%)**
Coursework	100%
Part-time Students:	Same as for full time students
Qualifying Condition(s)	

Pre-requisite/Co-requisites

None

Module Overview

This computational module will explore the various techniques used for the interfacing of equipment and signal processing in the context of radiation detection systems, and the use of Monte Carlo simulation techniques. The module will combine taught sessions and computational/laboratory work, and is taught in three parts:

Part 1 (Autumn Semester, 14 hours): LabView programming, covering an introduction to LabView, basic instrumentation control, and data analysis including GPIB, USB and serial protocols. Signal processing topics include Fourier Transforms, Windowing and Digital Filtering.

Part 2 (Spring Semester, 4 hours): Monte Carlo simulation of radiation interactions in matter: an introduction to the use of FLUKA simulation software.

Part 3 (Spring Semester, 20 hours): a laboratory-based group project to design and implement a digital radiation detection system, based on either a scintillator or semiconductor detector in conjunction with digital pulse processing.

Module Aims

The module will provide the student with an in-depth understanding of the use of the LabView software environment for instrumentation control, data analysis and pulse processing. Through a graded set of laboratory-based lectures and hands-on sessions, students will learn the theory and application of instrumentation control and data analysis, and apply these techniques to real applications using the LabView software. Students will also learn the basic use and implementation of the FLUKA Monte Carlo simulation software. The module culminates in a group-based design project where students develop a complete radiation detector instrumentation system of their choice.

Learning Outcomes

After completing this module, the student will have acquired the following:

Module Specific Skills:

- Understand the basis of instrumentation interfacing and control using the RS-232, USB and GPIB protocols
- Be able to design and write LabView programs for basic instrument control and signal processing tasks
- Critically understand and apply topics of elementary digital filtering and pulse processing algorithms

- Understand the basis of Monte Carlo simulation, and be able to design and write a FLUKA simulation programme.
- Perform a Design Project in a group, and orally present this work

Discipline Specific Skills:
- Gain expertise in digital pulse processing and multi channel analysis, and understand the principles behind radiation instrumentation control and signal processing
- Gain expertise in Monte Carlo modelling for radiation physics problems

Personal and Key Skills:
- Gain experience in group work through the design project
- Development of oral and communication skills in the presentation of project work

Module Content

This module is taught in three parts:

Part 1 (Autumn semester, 14 hours - Dr Paul Sellin):
LabView programming:
- Introduction to LabView and data-driven programming
- Advanced LabView techniques
- LabView DAQ signal acquisition and measurement
- LabView instrumentation control using VISA

Instrumentation interfacing and control:
- Introduction to instrumentation interfacing: serial and parallel interfaces, transfer rates and handshaking
- RS-232 and USB serial interface standards
- GPIB: hardware implantation and device command language

Signal processing:
- Signal generation and wave function generators
- Signal processing and filtering using Fourier Transforms: DFT and FFT
- Data acquisition software development using LabView

Part 2 (Spring semester, 4 hours - Dr Silvia Pani):
FLUKA Monte Carlo programming:
Introduction to Monte Carlo techniques in radiation physics
Use of FLUKA to carry out a simple detector modelling problem

Part 3: (Spring Semester, 25 hours - Dr Paul Sellin):
Design Project
Students will work together to design a radiation detection system using either a scintillation or semiconductor detector coupled to a digital pulse processing system. Using the LabView programming environment, students will design and implement the various aspects of detector instrumentation and interfacing, and assess the performance of their instrument.

Methods of Assessment

The module is 100% coursework assessed, based on the following programming and written assessments:
1. 2 LabView programming exercises in the Autumn Semester (20% per exercise)
2. FLUKA Monte Carlo programming exercise in the Spring Semester (20%)
3. Group Project Report (maximum 2000 words) describing the work carried out in the design project and the results obtained (50%)
4. Group Project Oral Presentation, summarising the work of the design project (10%)

The LabView and Monte Carlo assessments should be submitted electronically using ULearn.

Selected Texts/Journals

1. “Labview Signal Processing”, M.L. Chugani
2. “Labview programming, Data Acquisition and Analysis”, J.Y. Beyon
3. “Labview 7 Student Guide”, R.H. Bishop, Prentice Hall ISBN 0-13-188054-3

Option Module A: Particle Physics Detector Technology (University of Sussex)

Module Provider:	University of Sussex	**Module Code:**	PHYM025
Level:	M	**Number of Credits:**	15
Module Co-ordinator:	Professor Philip Harris (University of Sussex)		

Module Availability:
Spring Semester

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark(%)**
Coursework: problem sheets and exercises	100%
Part-time Students:	**Same as for full-time students**
Qualifying Condition(s) Physics programme regulations refer.	

Pre-requisite/Co-requisites

Students should normally have an undergraduate degree in Physics or Mathematics

Module Overview

The module explores some of the scientific questions being addressed in the fields of experimental particle physics, including high energy physics, neutrino physics etc. The student is introduced to some of the experimental techniques that are used to study the particle phenomena. The focus is on the demands those scientific requirements place on the detector technology and current state-of-the-art technologies.

This module is taught at the University of Sussex.

Module Aims

Specific aims are to provide students with:
(i) An introduction to some of the basic concepts of particle physics
(ii) An overview of some of the topical cutting edge questions in the field
(iii) An understanding of some key types of experiments
(iv) A detailed understanding of the underlying detector technologies

Learning Outcomes

After successfully completing the module, the students will be able to:
(i) Demonstrate a basic understanding of the standard model of particle physics and the observable phenomena from particle interactions
(ii) Discuss some key classes of experiments and answer quantitative questions regarding their design
(iii) Critically evaluate different detector technologies
(iv) Perform basic simulations of detector behaviour

Module Content

1. Intro to particle structure (6 hours)
(i) Particles and forces, masses and lifetimes
(ii) Coupling strengths and interactions
(iii) Cross sections and decays

2. Accelerators (6 hours)
(i) Principles of acceleration
(ii) Kinematics, center of mass
(iii) Fixed target experiments, colliders

3. Reactors (6 hours)
(i) Nuclear fission reactors, fission reactions, types of reactors
(ii) Neutron sources, absorption and moderation, neutron reactions
(iii) Nuclear fusion, solar and fusion reactors

4. Detectors (9 hours)
(i) Gaseous
(ii) Liquid (scintillator, cerenkov, bubble chamber)
(iii) Solid-state
(iv) Scintillation
(v) Calorimeters, tracking detectors
(vi) Particle identification

5. Monte Carlo modelling (3 hours)
Physics

Methods of Teaching/Learning
Lectures: 30 hours of formal lectures
Private study of specified articles

Selected Texts/Journals
Primary texts:
1. K. Kleinknecht - Detectors for Particle Radiation, C.U.P.
2. G.F. Knoll - Radiation Detection and Measurement, Wiley
3. R.K. Bock & A. Vasilescu - The Particle Detector BriefBook, Springer 1998 - available as internet version at http://www.cern.ch/Physics/ParticleDetector/BriefBook/

Secondary texts:
1. R. Fernow - Introduction to Experimental Particle Physics, C.U.P. 1986
2. W.R. Leo - Techniques for Nuclear and Particle Physics Experiments, Springer-Verlag 1987

Methods of Assessment
The module is 100% coursework assessed, based on open-book problem sheets and exercises.

Option Module B: Astronomical Detector Technology and Instrumentation

Module Provider:	University of Sussex	**Module Code:**	PHYM026
Level:	M	**Number of Credits:**	15
Module Co-ordinator:	Dr. Seb Oliver (University of Sussex)		

Module Availability:
Spring Semester

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark(%)**
Problem Sheet(s)	20
Individual Seminars on Telescopes/Instruments	10
Presentations on Science requirements	15
Presentations on Detector selection	20
Report on detector selection	35
Part-time Students:	Same as for full-time students
Qualifying Condition(s)	

Pre-requisite/Co-requisites

Students should normally have an undergraduate degree in Physics or Mathematics

Module Overview

The module addresses the detector technology required for Astronomical research.

This module is taught at the University of Sussex.

Module Aims

Specific aims are to provide students with:
(i) An overview of instrumentation and detectors
(ii) An overview of some of the topical cutting edge questions in the field
(iii) An appreciation of how scientific requirements translate to instrument/detector requirements and design

Learning Outcomes

After successfully completing the module, the students will be able to:
(i) Display a basic understanding of detectors in astronomy
(ii) Display communication skills
(iii) Distil technological requirements from scientific drivers
(iv) Make informed choice of detector for given application with justification

Module Content

1. A crash course in Astronomy and Astrophysics (6hrs + directed reading)
(i) Fluxes, luminosities, magnitudes, etc.
(ii) Radiation processes, black bodies, spectra
(iii) Stars
(iv) Galaxies
(v) Planets
(vi) Cosmology
(vii) Key questions
(viii) Key requirements

2. Telescopes & Instruments (3 hours student led seminars – from reading)
(i) Optical telescopes
(ii) Interferometry
(iii) Cameras

(iv) Spectroscopy
(v) Astronomy beyond the e/m spectrum

3. Detectors by wavelength (6 hours taught & 3 hours seminars)
(i) Gamma
(ii) X-ray
(iii) UV
(iv) Optical
(v) NIR
(vi) Mid-IR
(vii) FIR
(vii) Sub-mm
(ix) Radio

4. Detector selection for a future space mission X (4X3 hours)
(i) Scientific motivation and requirements
(ii) Detector options
(iii) External Constraints, financial, risk, etc.
(iv) Detector selection

Methods of Teaching/Learning

Lectures: 12 hours of formal lectures, 6 hours of student led seminars, 12 hours of problem based learning activity
Private study of specified topics

Selected Texts/Journals
1. Fundamental Astronomy: Karttunen
2. Handbook of CCD astronomy: Howell
3. Handbook of Infrared astronomy: Glass

Methods of Assessment
The module is 100% coursework assessed, based on open-book problem sheets, seminar presentations, and a written report.

Option Module C: Radiation Protection

Module Provider:	Physics	**Module Code:**	PHYM018
Level:	M	**Number of Credits:**	15
Module Co-ordinator:	Dr David Bradley		

Module Availability
Spring Semester

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark (%)**
Closed book examination	100 %
Part-time Students:	Same as for full time students
Qualifying Condition(s)	None

Pre-requisite/Co-requisites

None

Module Overview

This course describes the international legislative framework of radiation protection. From this starting point the course covers population and personal exposures to radiation, the principles of dose calculations, and example procedures for implementing radiation protection programmes.

Module Aims

To give a thorough understanding of the underlying philosophy and the practical implementation of the ICRP system of radiological protection. To encourage a quantitative approach to radiological protection; and to illustrate the need for a detailed understanding of the sources of radiation exposure and methods for applying the principles of radiation protection.

Learning Outcomes

After completing this module, the student should be able to:

Module Specific Skills:
- Demonstrate a critical analysis understanding of principles of radiation protection
- Ability to perform simplified dose calculations from original data to show problem solving aspects of such work
- Ability to understand case studies illustrating a holistic approach to radiation protection in a wide range of applications

Discipline Specific Skills:
- Critical analysis of data to gain ability to perform simplified dose calculations

Personal and Key Skills:
- Ability to understand case studies illustrating a holistic approach to radiation protection and methods for applying the principles of radiation protection

Module Content

Lecturer	Title	Lecture Hours	Lab Hours
Prof R Clarke	The history of radiation protection. Radiation risks. The ICRP system of radiological protection. Future recommendations of the ICRP	6	
Mrs D Peet	Basic Safety Standards, Ionising Radiations	6	
Mrs E Oakley	Environmental radiation, natural sources, man-made sources and population exposures	3	
Mr R Kenyon	Practical Radiation Protection	3	
Dr W Gilboy	Radiation shielding. Gamma-ray attenuation and build-up processes. Point kernel calculations and their application to extended sources	3	
Dr C Elliot	Assessment of Risk	3	
Mr N Smith	Nuclear Industry Safety Case Principles	3	
Mr R Major	Phases of decommissioning, radiation sources and controls, options and assessment methods, economic considerations and examples Waste management and disposal, categorisation and arisings, disposal routes, inventory management and assay techniques	6	

Methods of Teaching/Learning

Selected Texts/Journals

1. "Publication 60 - 1990 Recommendations of the International Commission on Radiological Protection", ICRP, 1991, Pergamon Press (ISBN 008 0411444)
2. "Becquerel's Legacy: A Century of Radioactivity", O'Riordan, M.C. (ISBN 1870965477)
3. "An Introduction to Radiation Protection", Martin and Harbison, Chapman & Hall, (4th Edition) (ISBN 0 412 631105)
4. "Radiation Exposure of the UK Population - 1993 Review", (NRPB-R311), Hughes, J.S. 1999 Review, HMSO
5. United Nations Scientific Committee on the Effects of Atomic Radiation, UNSCEAR 2000 Report Vol. 1. Sources, Vol. 2. Effects, United Nations New York, 2000
6. Radiation Protection Dosimetry, Vol 42, No 3 1992 – "Radon 2000" - Proceedings of a Conference, London, March 1992
7. Radiation Protection Dosimetry, Vol 48, No 1, 1993 – "Radiation Exposure of Civil Aircrew" - Proceedings of a Workshop, Luxembourg, June 1991

Methods of Assessment

This module is assessed in Paper V which will consist of 6 questions. Students answer 4 questions from the 6. Full marks for a question will be equivalent to 100 % of the total marks available in assessment of this module.

Option Module D: Applications of Ionising Radiation Physics

Module Provider:	Physics	**Module Code:**	PHYM009
Level:	M	**Number of Credits:**	15
Module Co-ordinator:	Dr David Bradley		

Module Availability
Spring Semester

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark (%)**
Closed book examination	100 %
Part-time Students:	Same as for full time students
Qualifying Condition(s)	None

Pre-requisite/Co-requisites

None

Module Overview

Ionising radiation is widely used for diagnostic and therapeutic purposes. The bulk of hospital physicists work with ionising radiation and hence the topic is fundamental for anyone entering the profession. An introduction is given to imaging systems: X-radiography, gamma cameras, X-ray computed tomography, single photon computer tomography (SPECT) and positron emission tomography (PET). An overview is given of radiotherapy techniques and the biological processes concomitant with this modality, together with discussion of isodose curves and variation with incident radiation energy.

Module Aims

To achieve an understanding of medical X-ray and gamma ray imaging technology in terms of equipment components and their performance and to relate this to the needs of diagnostic medical imaging. To give the student a broad overview of the techniques used *in-vivo* and *in-vitro* nuclear medicine studies. To provide an overview of the use of radiopharmaceuticals in nuclear medicine. To establish a basic appreciation of the operational aspects of radiotherapy treatment units and accessories, the radiation beams available and their interaction with tissues, together with clinical implications. An appreciation of quality management, its aims and application to imaging and radiotherapy.

Learning Outcomes

After completing this module, the student should be able to:

Module Specific Skills:

- Describe the physical principles and key technologies which determine the performance of medical X-ray imaging systems
- Describe the quality assurance cycle required for diagnostic X-ray and nuclear medicine equipment and to be familiar with test equipment commonly used for the most important measurements undertaken by physicists in an imaging department
- Describe the operation of treatment units and the radiation beams available together with their interactions in tissues and the clinical implications
- Describe details of the quality management system required in its application to radiotherapy facilities

Discipline Specific Skills:

- Use this knowledge when taking up posts within the Health Service and other related fields

Personal and Key Skills:

- Ability to use physics techniques in a multidisciplinary context
- Ability to evaluate the risks involved in a particular application

Module Content

Lecturer	Title	Lecture Hours
Dr K Wells	**X-rays, γ-rays, MTF and ROC Analysis** Mathematical formulation of the imaging system; linear operator, principle of superposition, impulse response function, stationarity, line spread function, edge spread function, convolution integral, MTF. Usefulness of MTF, modulation input and output, test objects, measure of performance, cascade MTFs. Perception of detail, visual acuity, resolution criteria. Existence of observer, decision criteria, confidence thresholds, conditional probabilities, types of decision. Construction of the ROC curve and principle of ROC analysis.	2
Dr A J Britten (4h) Dr S A Sassi (2h) Dr I Badr (4h) Mr A Rust (2h)	**X-ray Imaging and analysis** The X-ray tube construction and operational needs. X-ray scatter in diagnostic imaging and scatter reduction methods. X-ray film, intensifying screens and film-screen imaging performance. Non-film imaging: Image intensifiers and video X-ray images. Digital Subtraction Angiography. The production and use of digital medical X-ray images. Photostimulable phosphors and direct digital X-ray detectors. Introduction to quality management systems. The quality assurance or life cycle of x-ray equipment. The role of the physicist, radiographer and engineer. Types of x-ray equipment. Radiation safety and performance measurements on diagnostic and fluoroscopic equipment. Test equipment for the physicist. Published protocols. Measurement and significance of patient dose. Radiation safety design of x-ray rooms. Optimisation of patient exposure. The NHS Breast Screening Programme - organisation, facts and figures. Risk/benefit analysis in mammography. The profile of quality assurance and the role of the physicist. Elements of the mammographic imaging system: dedicated X-ray sets, films, intensifying screens and film processing systems. Use of various anode and filter materials to tailor the X-ray spectrum to individual patients. Effects of film processing on image quality and patient dose. Stereotactic biopsy systems and special procedures. Introduction to digital imaging modalities and their applications in mammography.	12
Dr M Masoomi (6h)	**Nuclear Medicine** Types of radionuclides used in medicine and methods of production. 'In vivo' and sample measurement techniques. Radionuclide imaging, design and QA of cameras and other imaging systems. Gamma-ray emission tomography and positron tomography. Dynamic studies. Whole body counting. Saturation analysis. Clinical applications of radionuclide techniques, tumour localisation and uptake, organ function, absorption studies,	12

	metabolic investigations. Comparison of radionuclide and other tests. Gamma probe; design and clinical application. Introduction to PET imaging. PET instrumentation; coincident events, scintillators, block detectors, 2D versus 3D, PET radioisotopes. Clinical application of PET.	
Dr J Ballinger (4h)	Radionuclides - review of decay modes and production methods. Preparation of radiopharmaceuticals - Pharmacopoeial requirements. Overview of radiopharmaceuticals - labelling methodologies. Diagnostic radiopharmaceuticals - selection of radionuclide, localisation mechanisms, clinical applications, protein and peptide based radiopharmaceuticals Therapeutic radiopharmaceuticals - selection of radionuclide, relevance of dosimetry studies, clinical applications *In vitro* studies	
Dr A D Hall (2h)	Molecular Imaging	12
	Radiotherapy and Treatment Planning	
Prof A Nisbet and relevant RSCH staff	Overview of role of radiotherapy and biological process. Interaction of X-rays and electrons with body tissues. Isodose curves and variation with incident radiation energy. Clinical advantages of high energy X-radiations. Production of X-radiation. Operation of X-ray therapy units, cobalt-60 teletherapy units and linear accelerators. Features of modern linear accelerators including those for conformal and intensity modulated radiotherapy. Sources of treatment errors and safety features in treatment units. Acceptance and routine tests of treatment unit performance. Quality Management Systems, ISO 9001 (2000) and quality assurance in radiotherapy. To introduce quality management, its aims and its applications to radiotherapy. External Beam Radiotherapy: Factors affecting dose. Treatment planning for kilovoltage, ^{60}Co and linacs (high energy photons and electrons). Planning techniques for single fields, two fields and multiple fields. Beam modifiers such as wedges, compensators. Planning techniques such as conformal radiotherapy and intensity modulated radiotherapy. Examples will be given. Brachytherapy: Interstitial and intracavity, radionuclides and techniques used, high and low dose rate and after-loading procedures. Four examples will be discussed in detail.	

Methods of Teaching/Learning

The module is taught by lecturers from both the Department of Physics and from hospitals.

Selected Texts/Journals

(i) Essential Reading

Radiation Oncology Physics. Ed. E.B. Podgorsak, IAEA, 2005
Linear Accelerators for Radiotherapy, Greene D, Adam Hilger (Medical Physics Handbook 17) 1986,
Physics of Electron Beam Therapy, Klevenhagen SCB, Adam Hilger (Medical Physics Handbook 13) 1985,
Medical Electron Accelerators, Karzmark CJ, Nunan CS & Tanabe E, McGraw Hill (1993),
Radiotherapy Physics (in practice), Williams JR & Thwaites DI. Oxford Medical Publications (1993),
The Physics of Three-Dimensional Radiation Therapy, Webb, S, IoP Publishing Ltd;., Bristol (1993)

The Physics of Radiation Therapy, Khan FM, Williams and Wilkins, 3rd Edn, 2003
Physical Aspects of Brachytherapy, Godden TJ, Adam Hilger 1988
The Essential Physics of Medical Imaging, Ed J T Bushberg, Williams & Wilkins, 1994
The Physics of Medical Imaging, Ed S Webb, IoPP, 2002
Medical Radiation Detectors, Editor N F Kember, IoPP, 1994
Physics for Radiologists. Dendy & Heaton, Taylor & Francis; 2nd Edn, 1999
Christensens Diagnostic Radiology, Lippincott Williams & Wilkins; 4th Edn, 1990
Textbook of Radiopharmacy: Theory & Practice. 3rd Edn, CB Sampson, Gordon & Breach, 1999
Basic Science of Nuclear Medicine, Parker, Smith & Taylor, Churchill/Livingstone, 1984
Textbook of Nuclear Medicine, Vol I: Basic Science, Vol II: Clinical Applications, Harbert & Da Rocha, Lea & Febiger, 1984
Practical Nuclear Medicine, Sharp, Gemmell & Smith. OUP 2nd Edn, 1998
Physics in Nuclear Medicine, Cherry, Sorenson, Phelps. Saunders, 3rd Edn, 2003
Medical Electron Accelerators, Karzmark CJ, Nunan CS & Tanabe E, McGraw Hill (1993),
The Physics of 3D Radiation Therapy, Webb, S, IoPP, 1993
Radiotherapy Physics in Practice, Ed: Williams & Thwaites, Oxford Medical Pub 2nd Edn, 2000
Practical Radiotherapy Planning, Dobbs J, Barratt A and Ash D, Edward Arnold 3rd Edn, 1999
The Physics of Conformal Radiotherapy, Webb S, IoPP,1997
Intensity Modulated Radiation Therapy, Webb, S, Institute of Physics Publishing Ltd. (2001)
Contemporary IMRT, Webb S, IoPP, 2005

(ii) Supplementary Reading

Guidance on the establishment and use of Diagnostic Reference Levels for Medical X-ray Examinations. IPEM Report 88, 2004.
IPEM, College of Radiographers and the NRPB, 2005. *Recommended Standards for Routine Performance Testing of Diagnostic X-ray Imaging Systems.* IPEM Report 91
IPEM, 1996-8. Measurement of the Performance Characteristics of Diagnostic X-ray Systems used in Medicine. Report 32 (2nd Edn). Part I: X-ray tubes and generators; Part II: X-ray image intensifier television systems; Part IV: X-ray intensifying screens, films, processors and automatic exposure control systems; Part V: Conventional tomographic equipment; Part VI: X-ray image intensifier fluorography systems.
Screen Film Mammography. G T Barnes & G D Frey. Medical Physics Publishing
Film Processing in Medical Imaging A G Haus. Medical Physics Publishing
Review of computerised radiography systems in the NHS. NHS BSP Equip. Rep. 0501, 2005
A cost comparison of full-field digital mammography with film-screen mammography in breast cancer screening. NHS BSP Equipment Report 0403, 2004
QA Guideline for Medical Physics Services NHS BSP Pub 33, 2nd Edn, 2005
Review of Radiation Risk in Breast Screening. NHS BSP Pub 54, 2003
Computer Aided Detection in Mammography. NHS BSP Pub 48, 2001
Performance of Mammographic Equipment in the UK Breast Screening Programme in 2000/2001. NHS BSP Pub 56, 2003
IPEM Rep. 89. The Commissioning & Routine Testing of Mammographic X-ray Systems, 2005
Screening for breast cancer in England: Past & future. NHS BSP Pub 61, 2006
Consolidated Guidance on Standards for the NHS Breast Screening Programme NHS BSP Pub 60, 2005
European Standard EN ISO 9001, European Committee for Standardisation, Brussels, 2000
ICRU Report 50, Prescribing, Recording and Reporting Photon Beam Therapy, 1993
ICRU Report 62, Supplement to Report 50, 1999
BJR Suppl. 25, Central Axis Depth Dose Data for use in Radiotherapy, BIR, 1996
Imaging in Biological Research, Part A (Methods in Enzymology, Volume 385) ISBN: 0-12-182790-9
Imaging in Biological Research, Part B (Methods in Enzymology, Volume 386) ISBN: 0-12-182791-7
P. Michael Conn (Series Volume Editor) Publisher: Academic Press Publication Date: 10 July 2004

A variety of review articles covering the field are available in the scientific literature, including: Molecular Imaging Perspectives, J R Soc Interface, 2005 (published online) Paul J Cassidy and George K Radda
Intensity-Modulated Radiotherapy: Current Status and Issues of Interest. Int. J. Radiation Oncology Biol. Phys., SI No. 4, 880-914 (2001)
European Standard EN ISO 9001 (2000), European Committee for Standardisation, Brussels (2000)

Methods of Assessment
This module is assessed in Paper III which will consist of 6 questions. Students answer 4 questions from the 6. Full marks for a question will be equivalent to 25 % of the total marks available in assessment of this module.

Module 8: Summer Project and Dissertation

Module Provider:	Physics	**Module Code:**	PHYM029
Level:	M	**Number of Credits:**	60
Module Co-ordinator:	Dr Paul Sellin		

Module Availability
Summer

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark (%)**
Coursework	Dissertation (100 %)
Part-time Students:	Same as for full-time students
Qualifying Condition(s)	

Pre-requisite/Co-requisites

None

Module Overview

For the summer project the students will work full time over a 3 month period from June to August. The project will be offered at either Surrey or Sussex, with topics chosen from a range of research areas that complement the elective modules offered in the spring semester. Alternatively students can elect to do the project with their employer, by mutual agreement between the department and the company.

All students aiming for the MSc degree qualification undertake an MSc dissertation project. Students choose a project either from a list of proposed topics within the University, or in some cases arrangement is made for the project to be undertaken in industry. The majority of part-time students arrange to undertake the project in their place of work.

Students are assigned a supervisor relating to the project chosen. Students undertaking their project outside of the University are assigned both an internal and an external supervisor.

The work is assessed as follows:

Project write-up
A write up of no more than 40 pages in total, including title page, brief abstract, text, diagrams and references must be submitted in accordance with the procedures written in Appendix B of the course handbook. Supervisors will give guidance on the layout of the project and the first draft of material where appropriate.

Module Aims

This module provides exposure to independent research at postgraduate level.

Learning Outcomes

After completing this module, the student should be able to:

Module Specific Skills:

- Application of research techniques to demonstrate problem independent solving ability, critical analysis and (where possible) original research of relevance to radiation physics work
- Perform a literature search
- Development of experimental / computation technical skills associated with radiation protection based project work

Discipline Specific Skills:
- Time management
- Report writing
- IT skills and communication
- Data evaluation and critical analysis

Personal and Key Skills:
- Written presentation of a formal report

Methods of Assessment

This module is assessed via a formal write up of the project undertaken in the form of an MSc dissertation. The Dissertation is awarded 60 credits.

Industrial Visits

Module Provider:	Physics		
Level:	M	**Number of Credits:**	0
Module Co-ordinator:	Prof Paddy Regan		

Module Availability
Autumn and Spring Semester

Assessment Pattern

Unit(s) of Assessment	**Weighting Towards Module Mark (%)**
None	-
Part-time Students:	Same as for full-time students
Qualifying Condition(s)	

Pre-requisite/Co-requisites

None

Module Overview

Industry visits are organised so as to give the student an insight into the types of working environment that they may choose to go into following the MSc course.

Supervised visits, with guided tours of some of the following organisations:

- Thermo Electron Radiation Measurement and Protection Services
- NUVIA
- Thermo Fisher Scientific

Module Aims

To give students an insight into Industry and to build depth in understanding of Radiation Detection and Instrumentation.

Learning Outcomes

After completing this module, the student should be able to:-

Module Specific Skills:
- Have knowledge of industrial applications of Radiation Detection and Instrumentation

Personal and Key Skills:
- Direct access to 'real life' industrial environments associated with radiation physics and protection

Methods of Assessment
None

SECTION G - STUDENT INVOLVEMENT

Student Feedback and Representation

There are several routes for students to provide feedback on the course and on teaching quality. For example, each student is asked for feedback through the lecture course assessment form (see Appendix C). Additionally, the Course Director is happy to receive feedback on progress and for raising any general or personal concerns. Additionally, there is student representation on both Staff/Student Liaison Committee and the Board of Studies.

Staff/Student Liaison Committee

The Staff/Student Liaison Committee (SSLC) comprises student representatives from each course in the department together with several academic staff and meets each semester to discuss any matters of general relevance to the courses. This Committee is a forum for frank and open discussion of any concerns relating to running of the degree courses and provides valuable feedback on teaching practices.

Board of Studies

The role of the Board of Studies (BoS) is to advise the Head of Department on matters relating to the academic content and running of the MSc in Radiation Detection and Instrumentation. The Board of Studies meets twice a year in June and December. The Chair of the BoS is Dr Zsolt Podolyak.

Student Feedback on Teaching

Following completion of each lecturer's presentations, questionnaires (see Appendix C) are distributed with feedback being reviewed by the course lecturers and Course Director.

Student Concerns or Grievance Procedures

The Departmental policy to be followed in the case of individual concerns or grievances is attached as Appendix E.

SECTION H - STUDENT WELFARE

Health Care
Medical Services are available through the Student Health Service located in University Court. The Student Health Service also maintains a list of local dentists and provides a counselling service.

Student Welfare
Help on academic or personal matters should be obtained, in the first instance, from the Personal Tutor or the Course Director.

Registration of Overseas Nationals
Students from countries who have been admitted to the UK for a period of 6 months or longer may be required to register with the Police. The fee at present is £34.00 for each person registering. There is also a charge for replacing a lost registration certificate. The requirement to register is stamped in your passport. The holder is normally required to register with the Police within seven days of arrival. However, as the Police visit the University in October; students are permitted to wait until ten. You must also inform the Police of any change of address.

Dates of registration will be shown in the MSc timetable.

When registering with the Police, students should bring with them the following:-
- their passport
- one passport type photograph
- the appropriate registration fee

Students must contact the International Office first to arrange an appointment – please ring +44 (0)1483 689005 or e-mail s.webb@surrey.ac.uk

Health and Safety Information
The Safety Policy is co-ordinated by the School Safety Officer (Mr C Stringer). Details of this policy are outlined through a presentation made during the Induction Days. Of particular importance to this course are the ionising radiation regulations. Students will be asked to read an abbreviated version of these regulations at the start of the course and must sign to acknowledge that they have read and understood these regulations.

A list of qualified first aiders is displayed in the departmental, together with the names of first aiders in adjacent departments.

Ethical Considerations
Thermoluminescent Dosimeter (TLD) Badges
Information obtained from the TLD badge forms an essential part of your lifetime dose record as a radiation worker. It is essential that this record is both complete and up to date. Each badge is processed independently by a commercial organisation to ensure the accuracy of the dose record. Every three months the dose must be recorded by sending the TLD insert from the badge for processing. Students are given information on when this needs to happen. If students do not meet the deadlines given, then a surcharge is made to the University. Therefore, it is policy that a deposit of £20 be obtained from all MSc students at the start of the academic year. This deposit will be returned in full at the end of the course, unless the student has failed to return one or more TLD badges on time. In this case the deposit will not be returned.

ALARA (As Low As Reasonably Achievable)
In order to promote good practice in handling of radioactive sources and the design of radiation experiments, the student will be required to subscribe to the principles of ALARA. This means that all radiation sources should be specified at the minimum activity consistent with performing the experiment in a reasonable time. As a result of this policy the department's safety record is very good and we expect our students to work to maintain this record.

Supervision of Projects
The Dissertation Project will be supervised by at least one member of the academic staff. This ensures that good radiation practice is taught to the student and that experiments proceed in a timely fashion.

Ethics Committee Approval in appropriate cases
In certain circumstances, it is necessary to obtain ethical approval to undertake a particular project where this involves administration of a radiation dose to a human being. Such projects are rare and when necessary the University Ethics Committee will be approached by the academic member of staff responsible for the project to obtain approval.

SECTION I – PRIZES AND SPONSORSHIP

PRIZES

The Lab Impex Prize
A prize of £300 is awarded annually for the best research dissertation on the MSc in Radiation Detection and Instrumentation course.

The Studsvik UK Ltd Prize
A prize of £400 is awarded annually for the best overall student performance on the MSc in Radiation Detection and Instrumentation course.

Winners will be announced at the Postgraduate Reception on Graduation Day in April 2011

SPONSORSHIP

Industrial Sponsorship

APPENDIX A: COURSEWORK MARKING CRITERIA

A1. LABORATORY EXPERIMENT REPORTS

These will consist of not more than 12 pages in total, including title page (with date experiment started), brief abstract, text, tables, diagrams and references. The text should follow standard format, i.e. aims of experiment, brief theory, description of apparatus and method (to the extent that this differs from the laboratory script, which must accompany the report), results, discussion and conclusions. Each report is marked using the marks sheet (below). Final grading levels can be compared with overall averages required to pass the MSc course.

70% and above	-	Distinction level
60-69%	-	Merit level
50-59%	-	Pass level
40-49%	-	Eligible for (module) Compensation Level
0-39%	-	Fail mark

Students are recommended to hand in reports in the week following each radiation laboratory session to obtain maximum feedback on their progress. At least two laboratory reports must be submitted by Friday 20 November 2009, and all must be submitted by the last day of the Autumn Semester, Friday 5 February 2010.

RDI students are required to write laboratory reports on at least two experiments from RDI21, RDI22, RDI23 or RDI24.

Part-time students must submit a total of five Laboratory Reports. The first two reports should be submitted by week 7 (Friday 20 November 2009) to allow constructive feedback and to ensure that the Laboratory Reports are of the required standard. At least one more Laboratory Report should be submitted before the end of the Spring semester in Year 1. The remaining two reports must be submitted by the end of the Autumn semester in Year 2.

In line with general regulations, a 25% penalty will normally be incurred for reports submitted up to one week after the deadline. Reports will normally receive a zero mark if submitted more than 1 week beyond the deadline.

The standard marking format used to assess Laboratory reports is shown overleaf:

MSc-RDI Lab Report Marking Form Experiment Title: .....

(Attach this form to each report) Student Name: .....

REPORT FEATURE	Inadequate	Sufficient	Good	Very Good Excellent Perfect
Title and Abstract: (Weighted at 3%) Check the report has a proper title, authorship and affiliation and is dated. Assess for conciseness and brevity (~200 words), description of purpose of experiment, mention of methods used and measurements made, summary of numerical results obtained and associated error, comparison with "accepted" values (if appropriate) and if abstract makes sense in isolation from report.	0 3 6 9 12	15	18	21 24 27 30
Introduction: (Weighted at 5%) Assess coverage of the aims and purpose of the experiment, why the experiment is interesting, useful or relevant, background, methodology, comprehensiveness and setting of context. Are appropriate references included?	0 5 10 15 20	25	30	35 40 45 50
Theory: (Weighted at 15%) Assess if theory section (if appropriate) is adequate. Have derivations or other material been needlessly copied verbatim from lab sheets or texts, or have only the salient points been properly noted (with references to appropriate sources)? If necessary, has any non-standard theory been included (or put in an appendix)? Are all equations numbered and symbols defined?	0 15 30 45 60	75	90	105 120 135 150
Experimental Arrangements and Techniques: (Weighted at 15%) Assess if clear diagrams of apparatus, and brief explanations of these, are included when necessary, whether figures are referred to properly in the text, whether the important and salient features of the techniques are clearly described. This material should *not* be copied verbatim from Lab Sheets.	0 15 30 45 60	75	90	105 120 135 150
Results and Errors: (Weighted at 15%) Assess mode of presentation, whether graphical or tabular, proper choice of scales on graphs, axes labels and units, symbols, error bars, etc., that all graphs are given titles, and these referred to in the text. Assess whether due consideration is given to experimental uncertainties, how these were obtained, whether they are good or poor estimates, whether any quoted numerical results also quote the errors and units, and that there is no unnecessary inclusion of arithmetic or standard error theory.	0 15 30 45 60	75	90	105 120 135 150
Discussion and Critique of Results: (Weighted at 25%) Assess whether sense is made of all the data, whether systematic errors that may have affected results are recognised, taken into account, or used to account for discrepancies. Check whether results have been properly compared to accepted values, where appropriate. Assess the discussion of the outcomes and the extent to which this shows a proper appreciation of their significance.	0 25 50 75 100	125	150	175 200 225 250
Conclusions and Summary: (Weighted at 10%) Assess the brief summary of the salient aspects of the experiment. and results, the conclusions drawn from the experiment and how convincing the argument for these is.	0 10 20 30 40	50	60	70 80 90 100
Acknowledgements and References/Bibliography: (Weighted at 2%) Are acknowledgements included if necessary? For list of references/bibliography, there should at least be a properly quoted ref. to the lab instruction sheets and any other sources of material e.g. text books, data sheets, literature etc. The list of references should be numbered sequentially and all referred to at appropriate places in the main text, using either: superscripts; [ ]; or abbreviated reference in parentheses e.g. (Einstein , 1951)	0 2 4 6 8	10	12	14 16 18 20
Presentation: (Weighted at 10%) Assess overall report format and presentation (i.e. is it properly arranged into typical sections as given above?). Assess its legibility, grammar, spelling, page numbering, style, clarity, readability, coherence, conciseness and length (~1500 words). Has material been plagiarised from lab sheets or other sources? (If the report is clearly plagiarised or otherwise deliberately falsified, a penalty of up to 100% may be deducted from the total report mark).	0 10 20 30 40	50	60	70 80 90 100
TOTAL REPORT MARK[1] (= sum/10)				

Feedback: Comments on any aspects where the report could perhaps have been improved

Assessor: In the table please circle a mark in the appropriate grade column and add up the total, then sum marks and divide by 10 to give the Total Report Mark out of 100. The weighting is automatically accounted for by the scale of the marks

Signature of Assessor and Date:.....

[1] "Very Good, Excellent, Perfect" (i.e., distinction or above ≥70%); "Good" (60-69%); "Sufficient" (50–59%); "Inadequate" or below (<50%)

A2: GROUP PROJECT REPORT AND ORAL

(a) Group Project Reports

A group project report should be prepared, consisting of a maximum 2000 words, and including a title page, brief abstract, text, diagrams and references.

It is recommended that the report is prepared using word processing facilities to yield a good quality presentation, while allowing ease of editing. The marking scheme below is used to assess these reports. The report should be prepared soft-bound, and submitted to the MSc Administrator no later than the deadline stated below.

The submission deadline for the Group Project Report will be during Week 13 of the Spring Semester. A 25% penalty will normally be applied for submission up to one week late, with a zero mark normally awarded for reports submitted more than 1 week beyond the deadline.

The written report is weighted at 50% of the total module mark, and is assessed using the following marking scheme:

Group Effort	15%
Theory	10%
Experimental Method	20%
Results and Errors	20%
Discussion & Conclusions	20%
Presentation of the Report	15%

(b) Group Project Oral Presentation

Each student will give a short oral presentation, as part of their group, describing the work carried out in the design project. The oral presentation, weighted at 10% of the total module mark, will be assessed using the scheme overleaf.

RDI MSc Group Project - Oral Assessment

Group: _____ Student:_____

Title: _____

Description	**Exceptional (5)**	**Very Good (4)**	**Good/Sufficient (3)**	**Marginal (2)**	**Unsatisfactory (1)**	General Comments
Organisation and Preparation	Extremely well rehearsed and organised. Speaker knows exactly what is to be said and when, and is thoroughly prepared.	Occasional hiccup during presentation but speaker generally very well organised and prepared.	Speaker reasonably prepared. Flow of presentation somewhat disrupted due to short-comings in organisation. May refer to notes.	Speaker poorly prepared, occasionally stopping to re-organise and to re-establish the flow of the presentation. May read from notes.	Very poorly prepared and organised with little or no effort made. Presentation made "on-the-fly".	
Content & Understanding of Presentation	Clear, exceptionally well explained, easy to follow with speaker in exceptionally good command of material.	Generally clear and very well explained. A few possible gaps in knowledge and a few possible shortcomings in explanation.	Speaker has reasonable knowledge of material. Some shortcomings in explanation and clarity. Occasionally difficult to follow.	Explanations lacking clarity, therefore difficult to follow material. Not well researched.	Speaker had not researched material and severely lacked knowledge base. Thus, explanations of a very poor standard.	
Visual Aids	Excellent, well chosen and readable. Appropriate number of slides and excellent use of colour.	Generally very good quality visuals, with a few shortcomings in readability, use of colour etc.	Good, but some significant shortcomings in quality of visuals, perhaps in their clarity and presentation.	Poor visuals, difficult to read, poor selectivity of material. Had a significant detrimental effect on presentation.	Very poor or non-existent visuals, scrappy or illegible, with lack of effort or care in presentation.	
Quality of Speech	Audible, lively varied tone, no hesitations, and correct speed of delivery.	Audible, some hesitation, possible shortcomings in tone and speed of delivery but overall a very good performance.	Hesitations, uncertain delivery at times, possibly monotone and possible shortcomings in audibility and speed.	Hesitant performance with fits and starts, generally monotone and possible problems with audibility.	Dull, very hesitant, real problems in delivery and possible audibility problems.	
OVERALL MARK (out of 20)						

Assessment Scheme for the Design Project Oral Presentation

APPENDIX B: DISSERTATION

Dissertations should not exceed 10,000 words or 40 pages in length (excluding full page diagrams, tables, references and appendices).

1. The substance of the dissertation

The students are expected to display imagination, initiative and scholarship in the preparation of their thesis. The thesis will remain an integral part of the research output of the University and will often be referred to by future student researchers.

Dissertations may be broadly classified into three types - a piece of original experimental or theoretical research, or a critical review. It is important that the student selects the dissertation topic carefully and in consultation with the prospective supervisor. During these discussions the scope and scale of the project should become clear to the student. Each type of dissertation requires a different approach and the students should consider their aspirations carefully.

2. The form of the dissertation

The length of the dissertation text should not exceed 40 pages and must be typed with 1.5 line spacing. A penalty of 5% of the total dissertation mark will be imposed at the discretion of the Examination Board for those students whose dissertation substantially exceeds this guideline.

The dissertation must be written in English. It is the student's responsibility to ensure clarity in presentation, although the supervisor may point out gross errors of spelling, punctuation and grammar. A poorly written dissertation may be returned by the examiners for correction before it can be accepted. S.I. units must be used throughout.

The content of the dissertation should include title page, abstract, acknowledgements, table of contents, text, references and appendices (if appropriate). Further particulars on thesis preparation may be found in the University Postgraduate Students' Handbook.

Figures and graphs should be placed close to the text to which they refer. Graphs must be labelled clearly and should include error bars where appropriate.

References are a vital part of the dissertation, and should enable the reader to find the relevant article or book without difficulty. They should include all authors' names and initials, year of publication, title of the article, title of the journal or book, volume number (underlined) and the page numbers.

The dissertation must be electronically prepared using Microsoft Word, LaTex, or similar word processing software, and then prepared as a PDF file. Submission of the dissertation to the course administrator must be in the form of (i) a complete electronic copy in PDF format, and (ii) a minimum of two paper copies. Bothe the paper copies and the electronic copy must be submitted by the published deadline.

Students are recommended to submit four paper copies of their thesis for binding, of which two will remain the property of the University, the student retains one copy, and one bound copy is provided to their supervisor.

3. Assessment

Dissertations will be assessed according to the following scheme:

Initiative	10%
Theory	15%
Investigation/Experimental	15%
Results/Errors	15%
Discussion	25%
Conclusions	10%
Presentation	10%

When a dissertation is conducted when on industrial placement, both the University and Industrial supervisors will mark the dissertation. The external supervisor's mark will count as 50% of the final dissertation mark; the internal supervisor mark will count as 50% of the final dissertation mark.

MSc Dissertations
Two copies should be submitted hard bound, which will be retained by the University on completion of the course. Typically the student will have four copies bound, two for the University, one for the supervisor and one to be retained by the student. The cost of binding must be met by the student. Addresses of suitable binding companies will be made available to the student. (Detailed guidelines for preparation and presentation of the dissertation thesis are given in Appendix B).

Students will be liable for payment of a continuing fee, in accordance with current University Regulations, in the event of late submission of a dissertation.

APPENDIX C: LECTURE ASSESSMENTS

(Specimen Copy)

MSc IN RADIATION DETECTION INSTRUMENTATION
CONFIDENTIAL LECTURE COURSE ASSESSMENT

This form, which is distributed towards the end of each semester must be completed and returned by the student to the MSc Administrator, Miss Alexia Smith 04AA02 before the end of the semester. The forms provide lecturers with valuable feedback on their teaching practices and methods with the aim of improving teaching standards. Student responses will be collated and returned to the individual lecturers involved. Based on this information any proposed action from the lecturer will be forwarded for discussion to the Course Director.

Lecturer:

COURSE PRESENTATION
Please tick a mark from 5 (Excellent) to 1 (Poor) and comment as appropriate:

	5	4	3	2	1
Course organisation and preparation					
Course content: Is it interesting?					
Course presentation/lecturing style					
Lecturer's clarity and volume of speech					
Lecturing speed: Is it satisfactory?					
Use of blackboard/overhead projector					

COURSE COVERAGE AND SUPPORT
Please tick a box

	Yes	No	Not applicable
Are you able to take good lecture notes?			
Do you receive handouts?			
Are you given the opportunity to ask questions in class?			
Is there unnecessary overlap with other topics taught?			
Is there any material **assumed** in the course which you have not met before?			
Have you used one of the **recommended course** textbooks on the reading list?			

COMMENTS:
Please make any comments concerning the above or any other aspect of the lectures.

(Continue over page)

APPENDIX D: ACADEMIC MISCONDUCT AND PLAGIARISM

It is unacceptable to the University of Surrey that any student registered with the University or one of its Associated Institutions for an award of the University should cheat in order to gain for him / her an academic advantage. The University will penalise any student who is found to have cheated in accordance with its Regulations for the Conduct of Examinations and Other Forms of Assessment.

The General Regulations specify that:-
It will be regarded as academic misconduct for any candidate to commit an act whereby he or she seeks to obtain for him / or herself, or for another candidate, an unfair advantage. Academic misconduct shall be taken to include:-

(i) impersonation of another candidate or knowingly allowing another candidate to impersonate him/her;
(ii) copying or communicating with another candidate in a formal, timed examination;
(iii) introducing into an examination room (including any anteroom or toilet) and making use of any manuscript or printed material not specifically permitted, any unauthorised calculator or other improper aid or source of information or communication;
(iv) plagiarism* or otherwise misrepresentation of his or her participation in and responsibility for any material submitted for assessment as part of a prescribed assessment;
(v) fabrication of the results of work which he or she claims to have undertaken (for example, experiments, interviews, observations or other forms of empirical research and investigation) which he or she has not carried out as claimed or presentation of results which he or she has not obtained.

* To plagiarise is defined as, “to take and use (the thoughts, writings, inventions, etc. of another person) as one’s own”,

(Concise Oxford Dictionary, 8th edition, 1990)

The University subscribes to an electronic plagiarism detection service and reserves the right to submit the work submitted by any student to that service for analysis.

If you are in any doubt about the appropriate procedures for acknowledging and referencing the work of others, you should seek advice from your Personal Tutor / Supervisor or Director of Studies.

Some guidance on the meaning of plagiarism is given below. If you are in any doubt about the appropriate procedures for acknowledging and reference the work of others, you should seek advice from your Personal Tutor / Supervisor or Director of Studies.

Guidance on the meaning of plagiarism

As part of a degree programme students are required to submit various types of coursework for assessment (examples include essays, laboratory reports, computer programs and dissertations). Whilst researching work students will normally read other people's work in books, journals, conference papers and lecture notes and therefore students should be aware that plagiarism occurs in the following cases:-

(a) Reproduction of all or part of the work of any other student or external author;
(b) Inclusion of portions of another text in your own work;
(c) Copying of phrases or sentences, or direct paraphrasing of these;
(d) Copying previously assessed work of your own without the agreement of your lecturer.

In many cases it is necessary to include quotations, sentences and paragraphs of other people's work, be it published or unpublished, in order to highlight a particular point. In such cases, any included text from another source (apart from that containing common knowledge) must be indicated by quotation marks or indented paragraphs that clearly identify the exact extent of this borrowed text, together with appropriate references.

Students who knowingly attempt to submit another person's thoughts, writings, arguments or ideas as if it were their own work, without explicit acknowledgement of the source and the extent of the quotations, are considered to be guilty of plagiarism.

At the time of submission of all coursework, students will be asked to sign a form to declare completion of the Coursework. Submission of the form will be taken as a declaration that the submission is wholly the student's own work and that all material attributable to others has been clearly identified and fully acknowledged and referenced to its original sources.

Procedure for Handling Allegations of Misconduct and Plagiarism
This will be carried out in accordance with the University General Regulations – Procedure for the Consideration of Allegations of Academic Misconduct and Related Penalties, University Calendar Section D121.

APPENDIX E: GRIEVANCE PROCEDURES

The following paragraphs summarise possible concerns that a student might have and describe the best procedures for solving them:-

1. Concern relating to the general content and/or general administrative arrangements associated with the student's course of study:

   These may be discussed with the Course Director, or tabled at the SSLC or the Board of Studies by the course representative.

2. Concern relating to examination and assessment:

   Concerns arising from examination and assessment procedures, or about decisions relating to progress on a course of study arising from such procedures, should be addressed in the first instance to the Head of Department (Professor P. M. Walker, Room 07BB03) or the Course Director.

3. Concern about the nature and quality of the general services and facilities provided by the University:

   Students should refer to the University Complaints procedures.

4. Concern of a personal nature:

   Students should contact the Course Director or, in extreme circumstances, the Pro Vice Chancellor with responsibility for student welfare.

APPENDIX F: SPECIAL NEEDS

Additional Learning Support

Additional Learning Support (ALS) provide a wide range of support for students with disabilities and specific learning difficulties (including dyslexia). The office is located on the 4th floor of the Library and houses the Technology Centre with specialist software and equipment. Phone 01483 689609 or email als@surrey.ac.uk http://lib1web.lib.surrey.ac.uk/ALS/

The University considers special arrangements for examinations and assessments for students with disabilities and SpLD. To apply for special examination arrangements you will need to complete an application form, which is available from Additional Learning Support. Examples of special arrangements which have been granted to students in the past include additional time in exams, rest breaks, access to a scribe, a PC or special furniture in exams. You may also be able to take exams in a separate room.

If you want to apply it is very important that you arrange for an interview with a Disability Advisor, as early as possible, within the first 4 weeks of the Autumn term. The two deadlines for applications for special examination arrangements are; 2nd November 2009 and 8th March 2010. You will need to supply evidence of your disability or special need and discuss what arrangements will be most appropriate. Students who arrive after this date (for instance during the Spring semester) should contact a Disability Advisor on arrival.

If your dyslexia assessment was completed before you were 16 years of age you will need a further 'performance of attainment' assessment to qualify for special examination arrangements or the Disabled Students Allowance (DSA).

Although you may have alerted a Disability Advisor of your needs at the admissions stage you will still need to make an appointment at the earliest opportunity when you start in the Autumn term. If you are dyslexic and do not have a current assessment, ALS can refer you to a specialist teacher or psychologist for one to be undertaken.

Once you have been granted special arrangements you do not need to re-apply each year, although you are advised to remind your departmental office of your special arrangements in advance of each exam, especially if a reader or scribe has been agreed.

Faculty and Departmental Support

Each Faculty has a disability representative who sits on the Learning Teaching & Assessment Disability Group (LT&ADG) and whose remit it is to promote best practice in relation to the provision of services to disabled students and students with SpLD within that Faculty or department.

Contacts re Disability or SpLD (e.g. Dyslexia)

Name	Role	Ext	E-mail address	Room
Cora Domburg	Faculty Disability Representative (LT&ADG)	6137	c.domburg@surrey.ac.uk	08BB04
Alexia Smith	Faculty* Postgraduate Disability Administrator	6133	a.m.smith@surrey.ac.uk	04AA02
ALS	Additional Learning Support	9609	als@surrey.ac.uk	10LB04

Emergency Medical Needs

It is usually possible to accommodate emergency medical needs, such as: overcoming the effects of a broken arm for example, right up until the examinations. These matters should be discussed directly with the Course Administrator (Room 04AA02), by telephone, extension 6133 (01483 686133), or by e-mailing a.m.smith@surrey.ac.uk.

APPENDIX G: MITIGATING CIRCUMSTANCES IN EXAMINATIONS AND COURSEWORK

The University Regulations allow Boards of Examiners to consider genuine and verifiable extenuating or mitigating circumstances, which may have prevented a student from attending an examination, submitting a piece of coursework or assignment by the due deadline or which may have affected their performance in that assessment.

In the interests of common understanding, the University has drawn up notes of guidance for students on the principles which underpin its consideration of mitigating circumstances, what it regards as acceptable mitigating circumstances and the sort of supporting evidence that Boards of Examiners will consider acceptable. These notes of guidance are available on the University's web pages at: http://portal.surrey.ac.uk/calendar/index.jsp and http://portal.surrey.ac.uk/portal/page?_pageid=719,1&_dad=portal&_schema=PORTAL

You should also refer to the guidance provided by the University's Health Centre on what it will and will not provide in the way of medical certification, at: http://www.unishealth.nhs.uk

APPENDINX H: RELIGIOUS OBSERVANCE

The University is a secular organisation and therefore privileges no religious faith or organization. The University accords full respect to all religious faiths, beliefs and practices equally as they are represented at the University, as is provided for in the University's Policy on Equal Opportunities. It is recognised that students may experience conflict between the demands of religious observance and the formal timetabled contact and assessment on their programme of study.

Students wishing to request an adjustment to teaching or assessment arrangements should make their needs known to the Course Director as early as possible. However, the constraints of scale in organisation of timetables may mean that it is not be possible to adjust arrangements to meet with particular needs of faith groups.

The Religious Observance Policy document can be accessed at the following web address: http://portal.surrey.ac.uk/policies/up/policystatementonreligiousobservation.jsp

APPENDIX I: GLOBAL GRADUATE AWARD IN LANGUAGES

The Language Centre - LC

All students whose first language is not English are required to take a one hour computer test organised by the LC. Depending on the results of this test, we may require you to attend English Language workshops during the first semester. These classes can significantly help you to pass the programme, particularly when writing up your project, and can also be helpful when finding a job at the end. Classes are FREE - take advantage of them. The Department will not be sympathetic to students who lose marks due to their report writing skills if they have not attended the English Classes that have been recommended to them. It is also possible to arrange English tuition for accompanying spouses etc. through the LC.

Global Graduate Award in Languages

The Language Centre is a specialised Language-teaching department which offers courses across the University and beyond. Through the courses you may study a foreign language, brush up on a half forgotten one or continue a language you have previously learned, regardless of your main subject. You will then receive a certificate of attendance recording your mark on completing the course. Registration will be online from 5 - 9 October 2009.

More information can be found at: http://www.surrey.ac.uk/languages/global-graduate-award/index.htm