Unit Description
This unit covers the essential physics of ionising radiation needed for applications in medical and nuclear physics. This includes production of ionising radiation, its fundamental interactions with matter, associated interactions of charged particles with matter, as well as radiation dose measurement quantities and techniques.

Coordinator: A/Prof Zdenka Kuncic: zdenka.kuncic@sydney.edu.au, rm. 415, School of Physics, ext. 13162

Lecturers
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Dr Stephen Bosi s.bosi@physics.usyd.edu.au

Lab supervisor
Dr Robin Hill robin.hill@email.cs.nsw.gov.au

Class timetabling
This is a 6 credit point unit and will be taught with a nominal contact of 3 hours per week over 13 weeks in Semester 1. Satisfactory completion of the unit will normally require additional self-motivated study time. The primary learning objective for students is to gain a solid understanding of radiation physics that will equip them with the specialised knowledge needed in professional occupations that deal with ionising radiation.

Lectures and Labs
Lectures
Lecture Theatre 4 (LT4)
School of Physics, A28

Labs
Lab experiments will be conducted at Royal Prince Alfred Hospital (RPAH) Department of Radiation Oncology, which is within walking distance from the University. As there is limited access to hospital equipment during normal working hours, labs will be conducted after hours on dates to be advised.

Assessment
Assignments (x2) 20% (10% each)
Lab quiz (x2) 10% (5% each)
End of semester examination 70% (35% RP, 35% D)

Assignments will be based solely on material presented in lectures and will be assessed by the respective lecturers. Assignments should be submitted by 5pm on the due date at Physics Student Services with a clearly labelled assignment cover sheet, unless instructed otherwise.

Lab work will be based on dosimetric measurements carried out as part of the lab experiments at RPAH. This work will be assessed by the lab supervisors.

The final exam will be based on lecture material only and will be assessed by the lecturers. 1 double-sided A4-size crib sheet is permitted into the exam. Calculators are also permitted.

Note: The final mark for this unit will be calculated by summing all the individual assessment marks with the appropriate weightings to form a total mark which may then be scaled and/or adjusted against a norm, in accordance with the University’s Academic Board Resolutions on Assessment and Examination of Coursework: sydney.edu.au/ab/policies/Assess_Exam_Coursework.pdf

Marks for Honours students may be scaled and/or adjusted relative to the norm for Honours. Raw marks for Honours students taking this unit will be forwarded to the Honours Year Coordinator, A/Prof. Stephen Bartlett.

Academic dishonesty/plagiarism
We will NOT accept assessments that are simply copied. Copying the work of another person without acknowledgment is plagiarism and contrary to University policies on Academic Dishonesty and Plagiarism: sydney.edu.au/ab/policies/Academic_Honesty_Cwk.pdf
Week-by-week timetable
The following timetable is indicative only and is subject to change. All PHYS5012 lectures are on Tuesdays, 0900-1200 in LT4, unless otherwise indicated.

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<th>Teaching Week</th>
<th>Date</th>
<th>Topic</th>
<th>Assessments Due</th>
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<td>Week 1</td>
<td>6 March</td>
<td>Sources of radiation (ZK)</td>
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<td>Week 2</td>
<td>13 March</td>
<td>Photon interactions (ZK)</td>
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<td>Week 3</td>
<td>20 March</td>
<td>Photon interactions (ZK)</td>
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<td>Week 4</td>
<td>27 March</td>
<td>Charged particle interactions (ZK)</td>
<td>Assignment 1 DUE</td>
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<td>Week 5</td>
<td>3 April</td>
<td>Charged particle interactions (ZK)</td>
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<td><strong>Mid-semester break 9-13 April</strong></td>
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<td>Week 6</td>
<td>17 April</td>
<td>Dosimetric quantities (LH? SB?)</td>
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<td>Week 7</td>
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<td>Dosimetric principles (PV)</td>
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<td>Week 8</td>
<td>1 May</td>
<td>Radiation detectors (LH)</td>
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<td>Week 9</td>
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<td>Week 10</td>
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<td>Lab 1</td>
<td>Assignment 2 DUE Lab quiz</td>
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<td>Week 11</td>
<td>22 May</td>
<td>3D dosimeters (SB)</td>
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<td>Week 12</td>
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<td>Relative/absolute dosimetry (LH)</td>
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<td>Week 13</td>
<td>5 June</td>
<td>Lab 2</td>
<td>Lab quiz</td>
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**Study week (11 – 15 June) Exams (18-29 June)**

Study resources

Main textbooks (copies available in the SciTech library, including special reserve):
- Podgorsak EB. Radiation Physics for Medical Physicists (2nd ed., 2010).
- Attix FH. Introduction to radiological physics and radiation dosimetry (1986).

Other reference books:
- Attix FH. Radiation dosimetry (1968).

All the above texts are available for general borrowing from the library. A copy of Attix has been placed on special reserve in the SciTech library. Podgorsak is also available as a library electronic resource (go to sydney.edu.au/library and search the catalogue under author name).

Sydney eLearning:
All course material and additional useful resources will be posted to the University's eLearning website, which requires a Uniky username and password that is issued with your confirmation of enrolment.
- elearning.sydney.edu.au

Honours students may need to request access to the eLearning site for this unit from Physics Student Services.
Topic overview

• Background and Production of Radiation
  Discovery of X-rays and Radioactivity
  Classification of Radiation
  Atomic Physics and Radiation
  Characteristic and Continuous Radiation
  Particle Accelerators

• Interactions of Photons with Matter
  Attenuation Coefficients
  Coherent and Incoherent Scattering
  Photoelectric Effect
  Pair Production

• Interactions of Charged Particles with Matter
  Stopping Power, Range
  Heavy Charged Particles
  Light Charged Particles
  Energy Deposition
  Radiation Yield
  Bremsstrahlung Targets

• Dosimetric principles, quantities and units
  Fluence and energy fluence
  Absorbed dose, Kerma
  Interrelationships
    Fluence and dose (electrons)
    Energy fluence and kerma (photons)
    Kerma and dose (electronic equilibrium)
    Kerma and exposure
    \( W_{av} \)
  Cavity theory
    Small, medium and large cavities
  Stopping power ratios
  Relative and absolute dosimetry

• Radiation Detectors and Dosimeters
  Desirable properties
  Ionisation chambers and electrometers
    Thimble
    Parallel plate
  TLD
  Film
  Solid state
  Tissue substitute material
  Gel dosimetry
Where to go for help

If you need help, you can
- as a first step, always check your unit eLearning pages for information, documents and links
- go to the Physics Student Services Office, Room 210 in the Physics building, or phone 9351 3037
- ask your lecturer or unit coordinator
- ask other students using the Discussion forum provided in the Discussions link on the unit eLearning page.
- consult one of the many services provided by the University, such as the Maths Learning Centre. These can be found at sydney.edu.au/current_students/student_services/index.shtml or through your MyUni pages sydney.edu.au/myni.

Consideration of factors affecting your study

If your academic performance in a Science Faculty unit of study is adversely affected by illness or some other serious event, such as an accident, you should notify the Faculty of Science Student Information Office (level 2 of the Carslaw building) within 7 days after the period for which consideration is sought, by completing an Application for Special Consideration with accompanying documentation. This is especially important if you miss an examination.

If you have another reason for the Science Faculty to take account of your circumstances (e.g. religious commitments, legal commitments, elite sporting or cultural commitments, or Australian Defence Force commitments) you should notify the Faculty of Science Student Information Office (level 2 of the Carslaw building) at least 7 days BEFORE the period for which consideration is sought, by completing an Application for Special Arrangements with accompanying documentation.

These two forms of Consideration should cover most allowable circumstances. However, if you have another reason for requiring the School of Physics to take account of your circumstances, you should notify Physics Student Services, Room 210, beforehand (or at the latest within 7 days afterwards), by completing an Application for Consideration of Special Circumstances by Physics with accompanying documentation.

You should not submit an application of any type if
- there is no assessment associated with a missed class, or
- you have a reasonable opportunity to make up any work you missed.

If, for example, you miss an assignment, an application for appropriate Consideration is required to allow late submission, but we do expect the assignment to be submitted. Sometimes catching up may be impossible, in which case we will consider a pro-rata adjustment of your marks on the basis of an application for Consideration.

Special Consideration or Special Arrangements

To submit an application for Special Consideration or Special Arrangements you should:
1. Obtain the appropriate Application pack from the Student Information Office of the Faculty of Science, the Faculty website at sydney.edu.au/science/cstudent/ug/forms.shtml, or Physics Student Services.
2. Complete the forms and obtain whatever original documentary evidence is appropriate. Note especially that the Professional Practitioner's Certificate is essential for Special Consideration on grounds of serious illness. Medical Certificates will NOT be accepted.
3. Take the original copy of all forms and documents, plus sufficient copies for each unit of study affected and yourself, to the Faculty of Science Student Information Office (NOT any other Faculty Office if you are seeking Consideration in a unit taught by Physics). They will sign/stamp both the original application form and the copies. In the case of Physics units, one copy of the documentation must then be submitted to Physics Student Services. Keep one copy yourself. A formal decision on your application will be sent to your university email address within 14 days.

Further details on University policy regarding Considerations can be found in policy documents entitled Assessment and Examination at the University Policy web site sydney.edu.au/policy.

Consideration by Physics

An application for Consideration by Physics requires you to:
1. Obtain an Application for Consideration of Special Circumstances by Physics from Physics Student Services or the Physics web page sydney.edu.au/science/physics/pdfs/local/consideration.pdf.
2. Complete the form and obtain whatever original documentary evidence is appropriate.
3. Take the original copy of the form and supporting documents, plus a copy for yourself, to Physics Student Services, Room 210. They will sign/stamp both the original application form and the copy. A formal decision on your application will be sent to your university email address within 14 days.

Students unsure what type of Consideration is appropriate, or unhappy with a Consideration decision, should consult Physics Student Services.