FACULTY OF SCIENCE

SCHOOL OF PHYSICS

PHYS3050

NUCLEAR PHYSICS

Session 2, 2011

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Faculty of Science - Course Outline

1. Information about the Course

NB: Some of this information is available on the UNSW Handbook[1]

Year of Delivery	2011
Course Code	PHYS3050
Course Name	Nuclear Physics
Academic Unit	School of Physics
Level of Course	3rd UG
Units of Credit	3UOC
Session(s) Offered	Session 2
Assumed Knowledge, Prerequisites or Co-requisites	PHYS3210 at a credit average or above
Hours per Week	2 HPW
Number of Weeks	12 weeks
Commencement Date	

Summary of Course Structure (for details see 'Course Schedule')

Component	HPW	Time	Day	Location
Lectures	2			
Lecture 1		12 – 1 pm	Tuesday	OMB 145A
Lecture 2		11am – 12 pm	Friday	Mech Eng 301
TOTAL	2			
Special Details				

2. Staff Involved in the Course

Staff	Role	Name	Contact Details	Consultation Times
Course Convenor		Dr J. Berengut	jcb@phys.unsw.edu.au	TBA
Additional Teaching Staff	Other Support Staff	Sue Hagon Higher Years Coordinator	s.hagon@unsw.edu.au Room 62B, Old Main Building 9385 6293	Drop in or by appointment

[1] UNSW Online Handbook: http://www.handbook.unsw.edu.au

3. Course Details

Course Description[2] (Handbook Entry)	Nuclear shell model; theory of beta decay; the deuteron; theories of nuclear reactions, resonances; mesons and strange particles, elementary particle properties and interactions; symmetries and quark models; strong and weak interactions.
Course Aims[3]	This course introduces subatomic physics, starting at the nuclear, then the hadronic level, and finally at the quark level. As well as the new application – subatomic physics itself – the student will learn about how the structure of quantum mechanics can be used with experimental results to obtain results without detailed calculations.
Student Learning Outcomes[4]	Students undertaking this course will gain a basic understanding of nuclear and particle physics. By the end of the course the student will be able to: • Apply the structure of quantum mechanics to a problem where the Hamiltonian is unknown a priori. • Estimate physical quantities of nuclei and other composite particles using simple relationships. • Identify the "elementary" particles of the Universe. • Use Feynman diagrams to understand subatomic reaction processes. • Perform simple calculations of decay rates. Additionally some of the Assignment tasks will require the student to use Mathematica to solve these problems.

Graduate Attributes Developed in this Course[5]

Science Graduate Attributes[5]	**Select the level of FOCUS** *0 = NO FOCUS* *1 = MINIMAL* *2 = MINOR* *3 = MAJOR*	**Activities / Assessment**
Research, inquiry and analytical thinking abilities		
Capability and motivation for intellectual development		
Ethical, social and professional understanding		
Communication		
Teamwork, collaborative and management skills		
Information literacy		

[2] UNSW Handbook: http://www.handbook.unsw.edu.au
[3] Learning and Teaching Unit: Course Outlines
[4] Learning and Teaching Unit: Learning Outcomes
[5] Contextualised Science Graduate Attributes

Major Topics (Syllabus Outline)	The Nuclear Physics Course consists of two parts. a) Physics of nuclei, including: • Deuteron, the simplest composite nucleus. The emphasis is placed on what we can learn about the strong nuclear interaction from properties of the deuteron and from proton and neutron scattering experiments. • Nuclear Shell Model. The model allows us to understand and to predict various nuclear properties such as "magic nuclei", nuclear magnetic moments, etc. • Single particle and collective nuclear excitations and electromagnetic transitions. • Beta-decay, which is a manifestation of the weak interaction. The decay is very important for understanding the stability of isotopes. • Parity nonconservation. This effect is due to the weak interaction, and it makes the weak interaction qualitatively different from the strong one. • Elements of the theory of nuclear reactions, the emphasis is on neutron reactions. b) Introduction to elementary particle physics, including • Classification of elementary particles, leptons, hadrons, and intermediate bosons. • Electroweak and strong interactions, conservation of lepton and baryon numbers. • Light quarks, mesons and baryons, strangeness. • Gluons, colour and confinement. • Heavy quarks and associated quantum numbers (charm, beauty, and truth), heavy mesons
Relationship to Other Courses within the Program	This course builds upon the foundations of quantum mechanics learned in the 2nd and 3rd year courses. Both the methods and results are a crucial step in understanding the theory of modern particle physics known as the Standard Model, which is explored further in the Honours Year course on Quantum Field Theory. PHYS3050 is part of the compulsory core required for those undertaking the Physics Honours program.

4. Rationale and Strategies Underpinning the Course

Teaching Strategies	New ideas and skills are introduced and demonstrated in lectures. Students develop these skills by applying them to specific tasks in assessments.
Rationale for learning and teaching in this course[6],	We believe that effective learning is best supported by a climate of enquiry, in which students are actively engaged in the learning process. To ensure effective learning, students should complement the lectures with readings from one of the many good textbooks on the subject. Lectures should be viewed by the student as an opportunity to learn, rather than just copy down lecture notes. Effective learning is achieved when students have a genuine interest in the subject and make a serious effort to master the basic material. The art of logically setting out problems and finding solutions is best learned by watching an expert and paying particular attention to detail. This skill is best learned by regularly attending classes.

[6] Reflecting on your teaching

5. Course Schedule

Some of this information is available on the Online Handbook[7] and the UNSW Timetable[8].

Week	Lectures (day), Topics & Lecturers	Tutorials (day), Topics & Lecturers	Practical (day), Topics & Lecturers	Other	Assignment and Submission dates (see also 'Assessment Tasks & Feedback')
Week 1	No lectures				
Week 2	Nuclear scales and units; deuteron				
Week 3	The nucleon-nucleon interaction; isospin				
Week 4	Scattering				
Week 5	Shell Model; corrections to shell model				
Week 6 *	Pairing; midsession test				
Week 7	Isotopes and excited nuclear states; decay				Mid Session test Friday 2 September
Week 8	Fermi theory of beta decay				
Week 9	Yukawa model; particles				
Week 10	Parity nonconservation				
Week 11	Interactions of leptons; quarks				
Week 12	Strangeness; SU(3)				
Week 13	Quark level interactions; Feynman diagrams				

*NB: As stated in the UNSW Assessment Policy: 'one or more tasks should be set, submitted, marked and returned to students by the mid-point of a course, or no later than the end of Week 6 of a 12-week session'

[7] UNSW Virtual Handbook: http://www.handbook.unsw.edu.au
[8] UNSW Timetable: http://www.timetable.unsw.edu.au/

6. Assessment Tasks and Feedback

Task	Knowledge & abilities assessed	Assessment Criteria	% of total mark	Date of		Feedback		
				Release	Submission	WHO	WHEN	HOW
Assignment 1			10%			i.e., Who will provide feedback?	i.e., When feedback will be given?	e.g., verbal, peer, marks
Midsession Test			20%	Friday 2 September				
Assignment 2			10%					
Final Exam			60%					

7. Additional Resources and Support [ensure copyright compliance is met]

Text Books	There are several good books available, and students are encouraged to find one that they like the feel of. Almost all books on nuclear and particle physics will cover the material set out in this course. Examples include • K. S. Krane, "Introductory Nuclear Physics", 1987 • E. Segré, "Nuclei and Particles", Second Edition.
Course Manual	Students should check the website http://www.phys.unsw.edu.au/PHYS3050/index.html
Required Readings	
Additional Readings	
Recommended Internet Sites	The School of Physics website is www.phys.unsw.edu.au Under the "Current Students" link students will find information about degrees, courses, and assessment. The University website www.my.unsw.edu.au provides links to the UNSW Handbook, Timetables, Calendars and other student information.
Societies	All Physics students are members of Physoc (the Physics Student Society) The Physoc room is 108, Old Main Building and all students are welcome to drop in anytime. A number of social events are organised each session. Further information is available online http://ugrad.phys.unsw.edu.au/physoc/ or email unsw.physoc@gmail.com The Australian Institute of Physics www.aip.org.au is the professional association of physicists in Australia.
Computer Laboratories or Study Spaces	Mathematica is available to students through the second year physics lab. It will be required for part of the Assignments.

8. Required Equipment, Training and Enabling Skills

Equipment Required	*N/A*
Enabling Skills Training Required to Complete this Course	*N/A*

9. Course Evaluation and Development

Student feedback is gathered periodically by various means. Such feedback is considered carefully with a view to acting on it constructively wherever possible. This course outline conveys how feedback has helped to shape and develop this course.

Mechanisms of Review	Last Review Date	Comments or Changes Resulting from Reviews
Major Course Review		
CATEI[9]	Annual	We welcome feedback at all times on presentation of course materials and any other course-related matters, and will be happy to discuss any issues raised in the lectures. You will be asked to provide evaluative feedback through UNSW's Course and Teaching Evaluation and Improvement (CATEI) Process at the end of the course.
Other	2008	The Physics degrees offered by UNSW are reviewed and accredited by the Australian Institute of Physics every five years.

[9] CATEI process

10. Administration Matters

Expectations of Students	Link to school policy including attendance at lectures and tutorials/laboratory classes/seminars; and computer use, such as, the use of email and online discussion forums. Generally the attendance requirement is 80% however this may differ between Schools. Students should check their UNSW email account regularly as all official university communication will be sent to that address.		
Assignment Submissions	Assignments should be submitted to your lecturer, or to the School of Physics office (Room 62, Old Main Building) by 5pm on the due date. Marks will be deducted for late assignments. A downloadable assignment cover sheet is available from http://www.phys.unsw.edu.au/phys_current/pdf/AssessmentCoverSheet.pdf		
Occupational Health and Safety[10]	Information on relevant UNSW Occupational Health and Safety policies and expectations is available at: http://www.ohs.unsw.edu.au/index.html		
Assessment Procedures **UNSW Assessment Policy**[11]	On some occasions, sickness, misadventure, or other circumstances beyond your control may prevent you from completing a course requirement or attending or submitting assessable work for a course. You should then apply for Special Consideration using the UNSW `Request for Consideration' form, found here: http://www.my.unsw.edu.au/student/atoz/SpecialConsideration.html. You should also contact your lecturer or Sue Hagon directly. All requests for special consideration must be accompanied by supporting documentation. You should note that merely submitting a request for Consideration does not automatically mean that you will be granted additional assessment, nor that you will be awarded an amended result.		
Equity and Diversity	Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course Convenor prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or http://www.studentequity.unsw.edu.au/ http://www.equity.unsw.edu.au/disabil.html). Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made		
Student Complaint Procedure[12]	**School Contact**	**Faculty Contact**	**University Contact**
	Prof Gary Morriss Undergraduate Director School of Physics Room 59D g.morriss@unsw.edu.au Tel: 9385 5240 or Sue Hagon Higher Years Coordinator School of Physics Room 62B, OMB s.hagon@unsw.edu.au	A/Prof Julian Cox Associate Dean (Education) julian.cox@unsw.edu.au Tel: 9385 8574 or Dr Gavin Edwards Associate Dean (Undergraduate Programs) g.edwards@unsw.edu.au Tel: 9385 6125	Student Conduct and Appeals Officer (SCAO) within the Office of the Pro-Vice-Chancellor (Students) and Registrar. Telephone 02 9385 8515, email studentcomplaints@unsw.edu.au

[10] UNSW OHS Home page
[11] UNSW Assessment Policy
[12] UNSW Student Complaint Procedure

	Tel: 9385 6293		University Counselling and Psychological Services[13] Tel: 9385 5418

[13] University Counselling and Psychological Services

11. UNSW Academic Honesty and Plagiarism

What is Plagiarism?

Plagiarism is the presentation of the thoughts or work of another as one's own.
*Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;
- paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle
† Adapted with kind permission from the University of Melbourne