THE UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF MATERIALS SCIENCE AND ENGINEERING

MATS 1142

CRYSTALLOGRAPHY AND X-RAY DIFFRACTION

Course Outline

Session 2, 2009

Course Staff

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Consultation hours:
By appointment

Timetable

Lecture/Tutorial	Day	Time	Location
Lecture/Tutorial	Monday	10:00 – 11:00	Central Lecture Block 1 (K-E19-G02)
Lecture/Tutorial	Wednesday	14:00 – 16:00	Central Lecture Block 1 (K-E19-G02)

Week	Monday	Wednesday
	10.00-11.00	14.00-16.00
1	Crystallography	Crystallography
2	Crystallography	Crystallography
3	Crystallography	Crystallography
4	Crystallography	Crystallography
5	X-Ray Diffraction	X-Ray Diffraction
6	Self study	Self study
7	X-Ray Diffraction	X-Ray Diffraction
8	XRD Tut./Lab.*	XRD Tut./Lab.*
9	XRD Tut./Lab.*	XRD Tut./Lab.*
10	XRD Tut./Lab.*	XRD Tut./Lab.*
11	X-Ray Diffraction	X-Ray Diffraction
12	X-Ray Diffraction	X-Ray Diffraction

* Organisation to be confirmed when course enrolment number is finalised.

Course Outline

Stream 1 – Crystallography	Stream 2 – X-Ray Diffraction
➢ Introduction to crystallographic nature of materials ➢ Crystal structure ➢ Bravais lattices ➢ Miller and Miller-Bravais indices ➢ Point and space groups ➢ Stereographic projection and its use in solving crystallographic problems	➢ Origin of X-rays ➢ Production and adsorption of X-rays ➢ Theory of diffraction of X-rays ➢ Powder and single crystal X-ray methods ➢ Applications of X-ray diffraction to problems in materials science (including laboratory and tutorials)

The learning and teaching philosophy underpinning the course (based on UNSW Learning Guidelines)

- **Students are actively engaged in the learning process.**
  It is expected that, in addition to attending classes, students read, write, discuss, and are engaged in solving problems in crystallography and X-ray diffraction and in the analysis of crystallographic aspects of materials behaviour.

- **Effective learning is supported by a climate of inquiry where students feel appropriately challenged.**
  Problems involving crystallography and X-ray diffraction are challenging; students will be given assignments and laboratory work that will motivate deep analysis of various crystallographic phenomena in materials science and engineering.

- **Learning is more effective when students' prior experience and knowledge are recognised and built on.**
  The course is built on prior courses in materials science, chemistry, mathematics and physics.

- **Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts**
  Students will be asked to analyse the role of crystallography and X-ray diffraction in understanding the relationship between crystallography, microstructure and properties in engineering materials.

Course information

Units of credit	3
Parallel teaching involved in this course	• Stream 1 – Crystallography • Stream 2 – X-ray Diffraction
How the course relates to other course offerings and overall program(s) in the discipline	• This course will provide the intellectual framework for a number of materials science courses such as phase transformations, mechanical behaviour, kinetics and diffusion, thermomechanical processing and others.
Course aims	• To gain a basic understanding of the crystallographic nature of materials and how this affects materials properties and the use of a range of X-ray diffraction techniques for characterising the internal structure of materials.
Graduate attributes which will be gained through the course	• Research, inquiry and analytical thinking abilities • Capability and motivation for intellectual development • Communication • Information literacy
Expected learning outcomes	*Students should gain:* • Enhanced critical thinking, analytical and problem solving skills in materials science and engineering. • An understanding of the crystalline state and its application to a broad range of materials and materials behaviour.

	• An understanding of the importance of a crystal structure on the mechanical, physical and other properties of materials. • An understanding of the principles of X-ray generation and diffraction and how the latter can be used to understand the atomic and molecular structure of a wide range of materials.
Teaching strategies	• Core concepts, theories and approaches to numerous problems concerning crystallography and X-ray diffraction will be covered in lectures. Examples will be provided to demonstrate these principles in materials science and engineering. Where appropriate, a number of tutorial and laboratory classes will be conducted to enhance problem solving skills with incomplete problems given as home work. • It is expected that students attending classes are prepared for discussion. • Teaching material, including the course outline, assignments, examples of solutions of problems, and course announcements are available on the Course Vista website.

Assessment	Assignments:	40%
	Combined final exam:	60%

Assignments will include two problem sheets in Stream 1, and one problem sheet and two laboratory experiments in Stream 2 in order to achieve learning outcomes and develop graduate attributes.

Assignments*		**Issue**	**Submission**
Stream 1	Assignment 1	week 2	week 3
	Assignment 2	week 4	week 5
Stream 2	Assignment 3	week 6 + 10	week 12
	Laboratory 1	weeks 8, 9	week 10, 11
	Laboratory 2	weeks 9, 10	week 11, 12

* Assignments will be issued when the class work is completed and not necessarily on the weeks noted above.

Note – All assignments and laboratory reports must contain a completed student declaration sheet and will be due on the date specified above. Late submissions will not be accepted without adequate reason in writing. Marked assignments and laboratory reports will be returned within two weeks of submission. Requests for special consideration must be submitted using the form available from the Student Desk in the Chancellery and must include medical certificates or other appropriate documents.

Final exam – This major exam will cover all aspects of the course consisting of formal lectures, nominated reading material (from course handouts) and assignments. It will consist of a combination of essay-style answers and calculations. Any derivations will assume knowledge of the material rather than committing equations to memory & relevant background equations will be provided.

Recommended Reference Materials

Stream 1

- B.D. Cullity, *Elements of X-ray Diffraction*, 3rd ed., Chapman and Hall, 2000.
- D. Hull and D.J. Bacon, *Introduction to Dislocations*, 3rd Ed., 1988
- R.E. Reed-Hill and R. Abbaschian, *Physical Metallurgy Principles*, 1992

Stream 2

- B.D. Cullity, *Elements of X-Ray Diffraction*, 3rd ed., Chapman and Hall, 2000.
- C. Barrett and T.B. Massalski, *Structure of Metals*, Pergamon.
- D. Hull and D.J. Bacon, *Introduction to Dislocations*, 3rd ed., 1988
- R.W.K. Honeycombe, *The Plastic Deformation of Metals*, 1968

Continual Course Improvement

- In the latter stages of the course, students will be asked to provide evaluative feedback through UNSW's Course & Teaching Evaluation and Improvement (CATEI) Process. Feedback from prior evaluations will be discussed in the first lecture of the course.
- 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.
- Students are also encouraged to address any issues regarding teaching of this course at the annual staff-student meeting.

Administrative Matters

- Students must attend at least 80% of all classes.
- Students unable to attend the mid-session or final exam on the health grounds should make a rrequest for special consideration by submitting the form available from the Student Desk in the Chancellery. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer.
- 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 convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or www.equity.unsw.edu.au/disabil.html). Early notification is essential to enable any necessary adjustments to be made. Information on designing courses and course outlines that take into account the needs of students with disabilities can be found at:

  www.secretariat.unsw.edu.au/acboardcom/minutes/coe/disabilityguidelines.pdf

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.