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## Nanoscience, Physics & Chemistry of Advanced Materials

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Website: <a href="http://www.tcd.ie/nanoscience/">http://www.tcd.ie/nanoscience/</a>

Nanoscience, Physics & Chemistry of Advanced Materials is a moderatorship taught jointly by the Schools of Physics and Chemistry. Administration of this course switches between Physics and Chemistry and is currently with the School of Chemistry (see contact details below). Building on the foundation courses taken in the Freshman years, students follow indepth courses across the spectrum of modern physics, physical chemistry, materials science and nanoscience.

## **Learning Outcomes**

On successful completion of this programme students will be able to:

- Articulate in written and oral form a foundation level of knowledge and understanding of Physics, Chemistry and Mathematics.
- Apply key concepts in Physics and Chemistry and key concepts in the Physics and Chemistry of Materials.
- Design and perform experiments in materials physics and chemistry, using modern
  physical and chemical experimental methodologies and instrumentation, with
  particular reference to materials, and analyse the results obtained from these
  experiments.
- Demonstrate skills in problem solving, critical thinking and analytical reasoning, and be able to effectively communicate the results of their work to chemists, physicists, material scientists and others, both verbally and in writing.
- Use modern library searching and retrieval methods to obtain information pertinent to the identification and solution of problems in the physics and chemistry of materials, and the exploration of new research areas.
- Work effectively and safely in a laboratory environment operating within the proper procedures and regulations for safe handling and use of chemicals and instruments.
- Design and perform appropriate experiments to address materials physics and chemistry problems, and analyse the results.
- Update their knowledge and to undertake further study with a high degree of autonomy.

# JUNIOR SOPHISTER

Junior Sophister:	The JS year consists of lectures, tutorials and practical work	
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	delivered in modules, as listed below. Students receive	
	training in communication skills within the practical module.	
Safety:	In order to reinforce and extend laboratory skills rising Junior	
	Sophister students are required to attend a day-long	
	workshop on Chemical and Laboratory Safety to be held on	
	<b>24 September 2015</b> . Attendance at this workshop is	
	compulsory.	
Mandatory Modules:	All modules specified below are mandatory.	
Assessment & Examination	The lecture material will be examined in examination papers	
Procedures:	taken during the Annual examination period. Two modules	
	may be examined in a single examination paper. Examined	
	modules are weighted according to their respective credit	
	rating, giving a total of 40 credits.	
	Continuous assessment of practical work contributes 20	
	credits of which 12% of this, or 2.5 credits are from the	
	communications skills and career development component.	
	A portion of the practical work will include some training in	
	techniques in materials science and nanoscience within the	
	Centre for Research on Adaptive Nanostructures and	
	Nanodevices (CRANN).	
JS marks contribute to 35% of the final degree Moderatorship mark		

# JUNIOR SOPHISTER MODULES - 60 ECTS

Module Code &	Semester	Description	ECTS
Name	(S)		
CH3104, Solid State Materials	S2	This module covers topics such as inorganic polymers, structural inorganic chemistry, synthetic methodologies and characterization techniques of solid state materials	5
CH3303, Quantum  Mechanical Concepts in Physical Chemistry	S1	This module deals with quantum mechanics, spectroscopy and group theory	5
CH3304, Molecular Thermodynamics and Kinetics	S2	This module deals with thermodynamics and statistical mechanics, electrochemistry and kinetics	5
CH3403, Analytical Methods	S1	This module deals with both the fundamental principles and application of spectroscopic and other characterization techniques. Topics such as analytical chemistry, organic spectroscopy and structural methods in inorganic chemistry will be covered	5
CH3093, Practical in Advanced Materials	S1 & S2	In this module students complete a number of advanced experiments in Physics, Chemistry and Materials Science. Minor components include training in communication skills, personal and career development and attendance at School Seminars	20
PY3P01, Quantum Mechanics	S1	This module covers solution of the Schrödinger Equation in specific topics, such as angular momentum and the hydrogen atom	5
PY3P02, Electromagnetic Interactions I	S2	This module covers the fundamentals of electromagnetic theory together with quantum optics and lasers	5
PY3P03, Condensed  Matter I	S1	This module introduces condensed matter concepts, such as crystal structure and thermal and electronic properties of matter	5
PY3P04, Condensed  Matter II	S2	This module extends the discussion of condensed matter into the key areas of magnetic properties and the physics of semiconductors	5

# SENIOR SOPHISTER

Senior Sophister:	The SS year consists of lectures, tutorials and practicals	
	delivered in modules, as listed below.	
	The major component of the practical module is an	
	independent research project in nanoscience, physics,	
	chemistry or advanced materials, which may be carried out at	
	a facility off-campus during the first term. Projects are also	
	hosted by the Schools of Chemistry and Physics and by	
	CRANN. Projects external to Trinity College are either hosted	
	by cognate universities or research institutes. A component	
	of problem solving and scientific comprehension is also	
	included in this module.	
Mandatory Modules:	All modules specified below are mandatory.	
Assessment & Examination	The lecture material will be examined by module in	
Procedures:	examination papers taken during the Annual examination	
	period. Two modules may be examined in a single	
	examination paper. Examined modules are weighted	
	according to their respective credit rating, giving a total of 35	
	ECTS. A paper on problem solving ability and scientific	
	comprehension, together with assessment of the research	
	project, contributes 25 ECTS in the ratio 30:70, respectively.	
SS marks contribute to 65% of the final degree Moderatorship mark		

# **SENIOR SOPHISTER MODULES - 60 ECTS**

Module Code &	Semester	Description	ECTS
Name	1 or 2		
CH4107 Advanced	S2	This core module involves lectures in quantum	5
Physical Chemistry II		chemistry and solid state chemistry	
CH4601 Materials	S2	This module deals with thermodynamics and	5
Chemistry 1		statistical mechanics, electrochemistry and kinetics	
CH4602 Materials	S2	This module involves lectures in	5
Chemistry 2		photochemistry and organic polymers	
PY4P03, Condensed	S2	This module covers metal physics and	5
Matter III		superconductivity together with	
		semiconductor devices	
PY4P04,	S2	This module covers the modified properties of	5
Nanoscience		nanoscale matter, its fabrication and potential	
		applications	
PY4P06, Modern	S2	This module covers optical properties of	5
Optics		materials and nonlinear optics	
PY4N07, Advanced	S2	This module consists of specialist courses in	5
Topics in		polymer physics, thin films and diffraction,	
Nanoscience		imaging and spectroscopy of nanostructures	
PY4NP1 Practical in	S1	This module combines a major research	25
Nanoscience		project with a component of general problem	
		solving in physics and chemistry	

## **Contact Details**

### **Course Director**

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## **Director of Teaching & Learning (UG)**

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#### This extract is important for all students:

#### Faculty of Engineering, Mathematics and Science

#### Annual examinations

18 Students must sit their annual examinations, which are held in the Trinity term, and must complete all other assessment components, as required. Junior and Senior Freshman students who have failed in the annual examinations must take a supplemental examination at the beginning of Michaelmas term. An expanded form of the following regulations giving further details of compensation requirements and other matters is available on request at the Science Course Office.

19 To gain a pass in each of the Freshman years, students must achieve an overall credit-weighted average mark of at least 40 per cent (grade III) and accumulate 60 credits by (a) passing all modules outright or (b) passing by compensation. To pass by compensation students must either pass outright modules totalling 55 credits and achieve a minimum mark of 30 per cent in the failed module, or pass outright modules totalling 50 credits and achieve a minimum mark of 35 per cent in any failed module(s). Junior and Senior Freshman students who do not pass at the annual examination session, either outright or by compensation, must complete supplemental assessments in all modules in which they did not achieve a mark of at least 40 per cent (grade III) by taking such assessment components, as required, during the supplemental examination period at the beginning of Michaelmas term.

Students who do not qualify to rise with their year and whose overall average mark is 35 per cent or higher, either in the annual or the supplemental examination can, as provided under general College regulations, repeat their year in order to improve their performance.

20 To pass the Sophister years, students must achieve an overall credit-weighted average mark of at least 40 per cent (grade III) and accumulate 60 credits either by (a) passing all modules outright or (b) passing by compensation or aggregation. Whether passing by compensation or aggregation students must pass outright modules totalling at least 40 credits in addition to achieving a 40 per cent (grade III) credit-weighted average, or higher, for the year. Compensation will be permitted in modules totalling a maximum of 20 credits provided that a minimum mark of 30 per cent has been attained in any failed module(s). Further, passing by aggregation will be permitted if a mark of less than 30 per cent has been achieved in a module or modules carrying up to a maximum of 10 credits provided that a mark of at least 30 per cent has been achieved in any remaining failed module(s). The designation of certain modules, or module components, as non-compensatable may reduce the level of compensation permitted in either Sophister year. There are no supplemental examinations in the Sophister years.

To qualify to proceed to the Senior Sophister year, students sitting the Junior Sophister examination must achieve an overall credit-weighted average mark of 45 per cent or higher in the overall examination.

Students who achieve an overall mark of 35 per cent or higher, but who do not qualify to proceed to moderatorship, can, as provided under general College regulations, repeat the Junior Sophister year in order to improve their performance.

21 Students whose overall mark is 34 per cent or lower in their annual examinations and supplemental examinations (if applicable) are not permitted to repeat their year and must withdraw from science.

#### Ordinary degree of B.A.

22 Students who pass the Junior Sophister annual examinations may have the ordinary B.A. degree conferred if they do not choose, or are not allowed, to proceed to the Senior Sophister year. Except by special permission of the University Council, on the recommendation of the Science Course Director, the ordinary degree of B.A. may be conferred only on candidates who have spent at least three years in the University.

#### Moderatorship examination

23 The Junior and Senior Sophister examinations constitute part I and part II of the moderatorship examination. There are no supplemental examinations. Students unavoidably absent from the moderatorship examination in their final year may apply to the Senior Lecturer to

M34 Calendar 2013-14

#### Appendix 2: Description of the European Credit Transfer System (ECTS)

The European Credit Transfer and Accumulation System (ECTS) is an academic credit system based on the estimated student workload required to achieve the objectives of a module or programme of study. It is designed to enable academic recognition for periods of study, to facilitate student mobility and credit accumulation and transfer. The ECTS is the recommended credit system for higher education in Ireland and across the European Higher Education Area.

The ECTS weighting for a module is a **measure of the student input or workload** required for that module, based on factors such as the number of contact hours, the number and length of written or verbally presented assessment exercises, class preparation and private study time, laboratory classes, examinations, clinical attendance, professional training placements, and so on as appropriate. There is no intrinsic relationship between the credit volume of a module and its level of difficulty.

The European norm for full-time study over one academic year is 60 credits. The Trinity academic year is 40 weeks from the start of Michaelmas Term to the end of the annual examination period 1 ECTS credit represents 20-25 hours estimated student input, so a 10-credit module will be designed to require 200-250 hours of student input including class contact time and assessments.

#### ECTS credits are awarded to a student only upon successful completion of the course year.

Progression from one year to the next is determined by the course regulations. Students who fail a year of their course will not obtain credit for that year even if they have passed certain component courses. Exceptions to this rule are one-year and part-year visiting students, who are awarded credit for individual modules successfully completed.

#### Appendix 3: College regulation regarding plagiarism – extract from the College Calendar 2014-15

#### **Plagiarism**

- 75 Plagiarism is interpreted by the University as the act of presenting the work of others as one's own work, without acknowledgement.
  - Plagiarism is considered as academically fraudulent, and an offence against University discipline. The University considers plagiarism to be a major offence, and subject to the disciplinary procedures of the University.
- 76 Plagiarism can arise from deliberate actions and also through careless thinking and/or methodology. The offence lies not in the attitude or intention of the perpetrator, but in the action and in its consequences.
  - Plagiarism can arise from actions such as:
- (a) copying another student's work;
- (b) enlisting another person or persons to complete an assignment on the student's behalf;
- (c) quoting directly, without acknowledgement, from books, articles or other sources, either in printed, recorded or electronic format;
- (d) paraphrasing, without acknowledgement, the writings of other authors.
  - Examples (c) and (d) in particular can arise through careless thinking and/or methodology where students:
    - (i) fail to distinguish between their own ideas and those of others;
    - (ii) fail to take proper notes during preliminary research and therefore lose track of the sources from which the notes were drawn;
    - (iii) fail to distinguish between information which needs no acknowledgement because it is firmly in the public domain, and information which might be widely known, but which nevertheless requires some sort of acknowledgement;
    - (iv) come across a distinctive methodology or idea and fail to record its source.

All the above serve only as examples and are not exhaustive.

Students should submit work done in co-operation with other students only when it is done with the full knowledge and permission of the lecturer concerned. Without this, work submitted which is the product of collusion with other students may be considered to be plagiarism.

- 77 It is clearly understood that all members of the academic community use and build on the work of others. It is commonly accepted also, however, that we build on the work of others in an open and explicit manner, and with due acknowledgement. Many cases of plagiarism that arise could be avoided by following some simple guidelines:
  - (i) Any material used in a piece of work, of any form, that is not the original thought of the author should be fully referenced in the work and attributed to its source. The material should either be quoted directly or paraphrased. Either way, an explicit citation of the work referred to should be provided, in the text, in a footnote, or both. Not to do so is to commit plagiarism.
  - (ii) When taking notes from any source it is very important to record the precise words or ideas that are being used and their precise sources.
  - (iii) While the Internet often offers a wider range of possibilities for researching particular themes, it also requires particular attention to be paid to the distinction between one's own work and the work of others. Particular care should be taken to keep track of the source of the electronic information

- obtained from the Internet or other electronic sources and ensure that it is explicitly and correctly acknowledged.
- 78 It is the responsibility of the author of any work to ensure that he/she does not commit plagiarism.
- 79 Students should ensure the integrity of their work by seeking advice from their lecturers, tutor or supervisor on avoiding plagiarism. All schools and departments should include, in their handbooks or other literature given to students, advice on the appropriate methodology for the kind of work that students will be expected to undertake.
- 80 If plagiarism as referred to in §75 above is suspected, in the first instance, the head of school will write to the student, and the student's tutor advising them of the concerns raised and inviting them to attend an informal meeting with the head of school, and the lecturer concerned, in order to put their suspicions to the student and give the student the opportunity to respond. The student will be requested to respond in writing stating his/her agreement to attend such a meeting and confirming on which of the suggested dates and times it will be possible for the student to attend. If the student does not in this manner agree to attend such a meeting, the head of school may refer the case directly to the Junior Dean, who will interview the student and may implement the procedures as referred to under CONDUCT AND COLLEGE REGULATIONS §2.
- 81 If the head of school forms the view that plagiarism has taken place, he/she must decide if the offence can be dealt with under the summary procedure set out below. In order for this summary procedure to be followed, all parties attending the informal meeting as noted in §81 above must state their agreement in writing to the head of school. If the facts of the case are in dispute, or if the head of school feels that the penalties provided for under the summary procedure below are inappropriate given the circumstances of the case, he/she will refer the case directly to the Junior Dean, who will interview the student and may implement the procedures as referred to under CONDUCT AND COLLEGE REGULATIONS §2.
- 82 If the offence can be dealt with under the summary procedure, the head of school will recommend to the Senior Lecturer one of the following penalties:
- (a) that the piece of work in question receives a reduced mark, or a mark of zero; or
- (b) if satisfactory completion of the piece of work is deemed essential for the student to rise with his/her year or to proceed to the award of a degree, the student may be required to re-submit the work. However the student may not receive more than the minimum pass mark applicable to the piece of work on satisfactory re-
- (c) submission.

83 Provided that the appropriate procedure has been followed and all parties in §81 above are in agreement with the proposed penalty, the Senior Lecturer may approve the penalty and notify the Junior Dean accordingly. The Junior Dean may nevertheless implement the procedures as referred to under CONDUCT AND COLLEGE REGULATIONS §2.

(pp. H16-H18 Calendar 2013-2014).

<sup>&</sup>lt;sup>1</sup>The Director Of Teaching And Learning (Undergraduate) may also attend the meeting as appropriate. As an alternative to their tutor, students may nominate a representative from the Students' Union to accompany them to the meeting.

## Appendix 4: Scheme for the marking of examination answers in Sophister years

Mark Ran	geCriteria
90-100	IDEAL ANSWER; showing insight and originality and wide knowledge. Logical, accurate and
	concise presentation. Evidence of reading and thought beyond course
	content. Contains particularly apt examples. Links materials from lectures, practicals and
	seminars where annronriate
80-89	OUTSTANDING ANSWER; falls short of the 'ideal' answer either on aspects of presentation or on
	evidence of reading and thought beyond the course. Examples,
	layout and details are all sound.
70-79	MAINLY OUTSTANDING ANSWER; falls short on presentation and reading or thought beyond the
	course, but retains insight and originality typical of first class work.
65-69	VERY COMPREHENSIVE ANSWER; good understanding of concepts supported by broad knowledge
	of subject. Notable for synthesis of information rather than
	originality. Sometimes with evidence of outside reading. Mostly accurate and
	logical with annonriate examples Occasionally a lanse in detail
60-64	LESS COMPREHENSIVE ANSWER; mostly confined to good recall of coursework. Some synthesis of
	information or ideas. Accurate and logical within a limited scope. Some lapses in detail tolerated.
55-59	SOUND BUT INCOMPLETE ANSWER; based on coursework alone but suffers from a significant
	omission, error or misunderstanding. Usually lacks synthesis of information or ideas. Mainly
	logical and accurate within its limited scope and with lapses in detail.
50-54	INCOMPLETE ANSWER; suffers from significant omissions, errors and misunderstandings, but still
	with understanding of main concepts and showing
	sound knowledge. Several lapses in detail.
45-49	WEAK ANSWER; limited understanding and knowledge of subject. Serious omissions, errors and
	misunderstandings, so that answer is no more than adequate.
40-44	VERY WEAK ANSWER; a poor answer, lacking substance but giving some relevant information.
	Information given may not be in context or well explained, but will
	contain passages and words, which indicate a marginally adequate understanding.
35-39	MARGINAL FAIL; inadequate answer, with no substance or understanding, but with a vague
	knowledge relevant to the question.
30-34	CLEAR FAILURE; some attempt made to write something relevant to the question.
	Errors serious but not absurd. Could also be a sound answer to the misinterpretation of a
	question.
0-29	UTTER FAILURE; with little hint of knowledge. Errors serious and absurd. Could also be a trivial
	response to the misinterpretation of a question.

Appendix 4: Guidelines on Marking for Project/Dissertation Assessment

Mark	Criteria
Range	
85-100	Exceptional project report showing broad understanding of the project area and excellent knowledge
	of the relevant literature. Exemplary presentation and analysis of
	results, logical organisation and ability to critically evaluate and discuss results coupled with insight
70-84	A very good project report showing evidence of wide reading, with clear presentation and thorough
	analysis or results and an ability to critically evaluate and discuss
	research findings. Clear indication of some insight and originality. A very competent
	and well presented report overall but falling short of excellence in each and every aspect.
60-69	A good project report which shows a reasonably good understanding of the problem and some
	knowledge of the relevant literature. Mostly sound presentation and
	analysis of results but with occasional lapses. Some relevant interpretation and critical evaluation of
	results, though somewhat limited in scope. General standard of presentation and organisation
50-59	A moderately good project report which shows some understanding of the problem but limited
	knowledge and appreciation of the relevant literature. Presentation, analysis and interpretation of
	the results at a basic level and showing little or no originality or critical evaluation. Insufficient
40-49	A weak project report showing only limited understanding of the problem and superficial knowledge
	of the relevant literature. Results presented in a confused or
	inappropriate manner and incomplete or erroneous analysis. Discussion and interpretation of result
	severely limited, including some basic misapprehensions, and lacking any originality or critical
20-39	An unsatisfactory project containing substantial errors and omissions. Very limited understanding, or
	in some cases misunderstanding of the problem and very restricted and superficial appreciation of the
	relevant literature. Very poor, confused and, in some cases, incomplete presentation of the results
	and limited analysis of the results including some serious errors. Severely limited discussion and
	interpretation of the results revealing little or no ability to relate experimental results to the existing
0-19	A very poor project report containing every conceivable error and fault. Showing virtually no real
0-13	understanding or appreciation of the problem and of the literature pertaining to it. Chaotic
	presentation of results, and in some cases incompletely
	presented and virtually non-existent or inappropriate or plainly wrong analysis. Discussion and
	interpretation seriously confused or wholly erroneous revealing basic misapprehensions.
<u> </u>	interpretation seriously confused or whomy enrolleous revealing pasic misappreficitions.

Schedu	e of Grades	
I	=70%+	
II-1	= 60-69%	
II-2	= 50-59%	
Ш	= 40-49%	
F-1	= 30-39%	
F-2	= 0-29%	
U.G.	= Ungraded	