# UNIVERSITY OF STRATHCLYDE

## DEPARTMENT OF PHYSICS

### 2009/2010 HANDBOOK

**for**

### 1st YEAR STUDENTS

MPhys

Honours BSc Physics

Honours BSc in Physics with Teaching

Honours BSc in Mathematics and Physics

This handbook should help guide you through your studies, but if you have any questions please do not hesitate to ask. Our friendly and experienced staff will be glad to help. We are one of the most successful physics departments in the UK and our teaching was awarded the top grade of "excellent" in the Government assessment of Scottish Universities. Our courses are accredited by the Institute of Physics. They are designed to be exciting, stimulating and rewarding. We think you will enjoy them as well.

With best wishes

David Birch
Head of Department

# Courses

## MPhys

This is a broad-based degree with an emphasis on modern physical principles. The final two years of this course differ from those of the BSc Physics degree in that students encounter classes on subjects that are necessary to produce a graduate physicist capable of working in a research environment in either industry or academia. As with the BSc degree, students can choose optional classes in Year 4 and then extend the depth of coverage of these subjects through Year 5.

Within the MPhys degree structure, there is the opportunity for students to tailor their classes in the final two years to a give specialisation in a particular subject area. This is done by choosing selected classes relating to a certain area of expertise offered by the department and pursuing a final-year project in that area. Students who are interested in following such a path enter the university initially as MPhys students and make their choice of specialisation at the beginning of Year 4.

## Honours BSc Physics

This is a comprehensive degree providing students with a thorough grounding in the fundamentals of physics. During the final year of the course, students can select optional classes from a range of diverse topics from theoretical physics through plasma physics to photonics.

## Honours Physics with Teaching

This degree is offered in conjunction with the Faculty of Education and is a qualification that is designed to prepare graduates to be teachers of physics in secondary schools. This degree not only covers the same core syllabus of the BSc Physics degree but also allows students the time to acquire the educational theory and classroom practice necessary for registration with the General Teaching Council for Scotland.

## Honours BSc Mathematics and Physics

The aim of this degree is to provide students with a joint qualification in Mathematics and Physics by providing the opportunity to pursue Mathematics and Physics to a high level. It contains the physics necessary for future fundamental and applied work, along with computational and theoretical physics.

# CONTENTS

Our best wishes for your studies during this academic year, 2009/2010. We welcome you and hope that you will enjoy your time with us. We cannot hope to make a physics degree easy: it would not be worthwhile if it was, and it takes many years of hard work - but we will do all we can to make it an enjoyable experience, and to provide you with the facilities to make your studying as effective as possible.

## THE ACADEMIC YEAR 2009/2010

**REGISTRATION :** **Monday 21st September 2009 – Friday 25th September 2009**

(*Interviews with Advisers of Study are arranged during this week)*

Important events which you must attend during this week, if you are in your first year of study, are

**Faculty Induction Session on 23rd September 2009 between 12.00 noon – 2.30 p.m. in Room 3.25 of the John Anderson Building.**

**First Day Meeting on Friday 25th September 2009 from 10.00 – 11.00am in room JA4.13 of the John Anderson Building.**

**SEMESTER I :**

| | |
|---|---|
| **University closed** | **Monday 28th September 2009** |
| **Teaching Weeks 1 – 12** | **Tuesday 29th September 2009 – Friday 18th December 2009** |
| **Christmas Vacation** | **Saturday 19th December 2009 – Sunday 3rd January 2010** |
| **University closed** | **Thursday 24th December 2009 – Sunday 3rd January 2010** |
| **Revision Week** | **Monday 4th January 2010 – Friday 8th January 2010** |
| **Examination Weeks** | **Monday 11th January 2010 – Friday 22nd January 2010** |

**SEMESTER II :**

| | |
|---|---|
| **Teaching Weeks 1-12** | **Monday 25th January 2010 – Friday 30th April 2010** |
| **Spring Vacation** | **Monday 5th April 2010 – Friday 16th April 2010** |
| **University closed** | **Friday 2nd April 2010** |
| **University closed** | **Monday 5th April 2010** |
| **Revision Week** | **Monday 3rd May 2010** |
| **Examination Weeks** | **Monday 10th May 2010 – Friday 4th June 2010** |
| **University closed** | **Monday 3rd May 2010** |
| **University closed** | **Monday 31st May 2010** |

**Resit Examinations begin** **Wednesday 4th August 2010** (normally of two weeks duration)

## GENERAL INFORMATION

**The Further and Higher Education Charter** for Scotland was published in 1994. A leaflet outlining its main points is available from Registry (the University's Administration, in the McCance Building). The University's teaching was inspected by the Enhancement Lead Institutional Review (2005) and was given the highest rating possible.

The Faculty of Science includes the Departments of Physics**,** Mathematics and Statistics, Computer & Information Science, Pure & Applied Chemistry as well as the Strathclyde Institute of Pharmacy and Biomedical Sciences which comprises the many bioscience departments. The Faculty, one of five in the University, has administrative and financial powers devolved to it by the University.

The current office-holders in the Faculty (appointed from and by the academic staff of the Faculty) are:

| | |
|---|---|
| Dean: | Professor Iain Hunter |
| Vice-Deans: | Professor Alexander Cunningham (Resource) |
| | Professor Kathie Kane (Research) |
| | Dr Des McGhee (Academic) |

Permanent administrative staff of the Faculty (based in the McCance Building) are:

| | |
|---|---|
| Faculty Officer: | Dr Jim McGrath |
| Assistant Faculty Officer: | Ms Jill Smith |

Enquiries to Faculty staff can be presented at the Faculty of Science enquiry desk in the McCance Building. [They also deal with changes of address, changes of registration for classes or courses, medical certificates and the administration of the Examination Boards that consider your end-of-year examination results.]

The Department is housed mainly in the **John Anderson (JA) building**, but some staff have offices and laboratories in the adjacent Colville (Col.) Building, linked at levels 3, 4 and 5. The John Anderson Building is open Monday to Friday from 8.00 am to 10.00 pm. After 6.00 pm access is only via the main door (level 5) or via the Colville Building as the subsidiary entrances are locked to maintain security.

The Department makes available JA8.18 (The Bob Illingworth Room) as a **Student Reading Room**. You are asked to cooperate by not using 8.18 for conversing, eating or drinking. This room is for students of all years, and of all courses. (Please treat it with care, or else the facilities will be withdrawn.) There is a student common room JA 5.12

The Department has over **30 academic staff.** The Head of Department (2007/2010) is Professor David J. S. Birch (JA 8.02).

Information on the Department and its staff can also be obtained from the Department Website http://phys.strath.ac.uk

Should you need to contact a member of staff, contact details can also be found on the Department Website http://phys.strath.ac.uk/information/people/people.php . Alternatively, messages for staff may be left in their pigeonhole on the 8th floor of the John Anderson Building, outside JA 8.31. (Please note, names are above pigeonholes, not under.) Besides its academic staff, the Department also includes research fellows, research assistants and research students who, besides their research activities, participate in the teaching of the Department. In addition there are also technical and secretarial staff. **Photographs** of all the staff are displayed on the **8th. Floor of the John Anderson Building** outside JA 8.03.

The Department uses the internet to communicate with students and so it is essential that you check both your university email account and the Faculty of Science VLE, SPIDER, daily.

On timetables and notices, each building on the Campus is identified by a prefix. Originally these were mostly single letters, and the John Anderson Building was denoted by K. This is still used by the University in its timetables for classes and examinations, but the more user-friendly notices issued by the Department use two letter building prefixes, like JA for the John Anderson Building, LT for the Livingstone Tower, etc.

## YOUR DEGREE COURSE

### Course Requirements

Each degree course is made up of a number of classes. A full year's curriculum normally totals a minimum of 120 credits. Your list of classes to be studied must be agreed with your Adviser (see below) and then you will be able to complete your registration with the University. The syllabus and book list for the main classes given by this Department can be found at http://phys.strath.ac.uk/undergraduate/classes.php

Each degree course is governed by a set of Regulations that specify the compulsory classes you must follow for that degree course as well as the progress requirements to move from one year to the next year of a given degree course. These Regulations can be downloaded from http://phys.strath.ac.uk/undergraduate/handbook. In addition to the Regulations that are specific to your chosen course you are bound by a set of general regulations and these can be read at http://phys.strath.ac.uk/undergraduate/handbook

### At the Start of the Year

All students receive an invitation to meet their **Adviser of Study** before registration during "Week 0", 21st – 25th September 2009, the week before teaching starts. First Year students will receive theirs with their Registration Form, whereas other years will generally receive theirs direct from the Department.

Your adviser will discuss with you those classes that will be included in your curriculum. Timetables will also be available then. Degree courses include compulsory classes and elective classes. The latter may be chosen from most classes in any Faculty providing that the timetable permits. (Some classes however are barred as being too close in content to your course's compulsory classes.) All classes have a credit value that you obtain if you pass the class examination. Once the full list of all the classes to be studied has been agreed with your adviser will approve your curriculum and then you can register

It is important that your **class registration** be correct as, amongst other things, it is used to check the feasibility of draft exam timetables. You may change your list of classes through PEGASUS, the University's VLE, but there are restrictions on changing your classes more than 2 weeks into the semester. Any change needs the approval of your Adviser.

### Timetables

The timetables for each degree course will be available on the Departmental website at the start of each semester.

http://phys.strath.ac.uk/undergrad/timetable/semester1.php

http://phys.strath.ac.uk/undergrad/timetable/semester2.php

## Advisers of Study

*The Course Advisers for 1st year:-*

| | |
|---|---|
| MPhys | Dr. N. Langford, JA 8.17 ext. 3077 |
| Physics BSc Honours | Dr. N. Langford, JA 8.17 ext. 3077 |
| Physics with Teaching BSc Honours | Dr. N. Langford, JA 8.17 ext. 3077 |
| Mathematics and Physics BSc Honours | Dr P. Knight, LT 9.32 ext 3818 |
| Natural Sciences BSc | Dr. A. B. McCruden, SIBS 4.59 ext. 3749 |

### Counsellors

As well as an Adviser of Study, students are also allocated to a Counsellor, who is a member of the academic staff. The Counsellor's role is to make your progress through your university studies as free of problems and difficulties as possible. You should receive a copy of a booklet about being a student which explains the Counsellor scheme more fully. You should meet your Counsellor as soon as possible after the start of term. Should problems arise with the counselling arrangements see Dr. N. Langford (JA 8.17) who organises counselling for the Department.

As your course progresses, students often find that their problems are more academic than personal, so your Adviser may be of greater help in these cases. But try to keep in touch with your Counsellor so that there is always at least one member of the academic staff who is aware of your special needs and circumstances.

The Department has a **Student-Staff Committee** (Convener Dr O. Rolinski) that is made up of student representatives from each year and a number of academic staff. Students are invited to choose their own representative in the first two weeks of the first term. The Committee has an important role, resolving difficulties that may arise. The Students Association offer training on how to be an effective representative. The Committee considers anything that affects the teaching of the courses or Student-Staff relations. Problems that are personal to you should be raised with your Counsellor or Adviser. Matters affecting a group of students should be raised in the first instance with any staff member directly involved, but if this fails to resolve the matter, or if it raises wider issues, then ask your Student-Staff Committee Representative to raise it at their next meeting.

### Textbooks

Obtain your essential **textbooks** at the first opportunity. Book Trader in the Students Association holds over 1000 second hand books being sold by students at half price or less. You may wish to check here before venturing forth to pay the full price for your necessary textbooks. Book Trader can be found in *ask4* on level 4 of the Students Union.

The first year textbook is "University Physics (Revised Edition)" by Benson, Wiley 1996 (ISBN 0 471 00689-0) available from the University Bookshop, Curran Building on Cathedral Street. Buy this book as soon as possible since you will need it from week 1 onwards.

## REPORT WRITING

A key skill for any physicist is to communicate the outcomes of an investigation to a wider audience. During your course you will be expected to write formal reports on the practical work that you undertake in years 1 to 3 and the final year projects that you take in your $4^{th}$ and $5^{th}$ year of study. During the first three years of your study at Strathclyde the Department will give you the necessary training on how to write a report and this will include advice on the structure and content of the report, how to reference and how to avoid plagiarism.

## ADVICE FOR STUDENTS WITH SPECIAL NEEDS

The University is committed to supporting students with special educational needs, which may range from dyslexia to mental health problems. To this end the University has a dedicated unit, the Disability Service. Please refer to your University Handbook for further details and see http://www.strath.ac.uk/disabilityservice/

To ensure the department meets your needs as defined by the Disability Service, two Departmental Disability Contacts have been appointed. Should you have any questions then please do not hesitate to contact either Kirsten Munro ( kirsten.munro@strath.ac.uk ) or Dr T. Han ( t.han@strath.ac.uk ).

### SAFETY REGULATIONS

These apply to all parts of the University. Your attention will be drawn to these when they affect you. Particular care needs to be exercised in laboratories, and in general, you are not allowed to work in a laboratory unsupervised. For this reason, it is not usually possible to make up time lost for any reason during a laboratory session by putting in extra time later. The Department's safety rules are listed at the back of this handbook.

### INFORMATION TECHNOLOGY, PEGASUS AND SPIDER, AND PERSONAL TRANSFERABLE SKILLS

Expertise in *information technology* (IT) and well developed *personal transferable skills* are essential if you are to maximise your performance in the academic work of your chosen course. Essays, laboratory and project reports, for example, must normally be word processed while the ability to analyse and plot experimental data using available software packages is essential for progress in scientific research. Familiarity with IT also allows you to search the internet and electronic databases for reference material to assist in the writing of assignments and dissertations. In the later years of the course, the emphasis on project work trains you in the planning and performance of research, while the preparation and delivery of presentations, gives you the confidence to communicate your results and their relevance to both specialists and non-specialists as is required of professional scientists.

*Year 1:* *Laboratory reports, spreadsheets, e-mail, internet,*

*Year 2:* *Laboratory reports, library skills and the preparation and delivery of a talk.*

*Year 3:* *Laboratory reports, essay, project training, industrial project and its written and poster presentation, problem solving.*

*Years 4 & 5:* *Research project and its written and oral presentation, problem solving, research training and communicating physics.*

### PEGASUS and SPIDER

The University has developed its own information server known as PEGASUS that is used to provide services to both staff and students. Please refer to your University Handbook for further information. In addition to PEGASUS the Faculty of Science has its own information server, SPIDER, and this is used to provide copies of lecture notes, assignments, tutorial questions etc., as well as providing discussion forums for students. As with PEGASUS you will receive training on the use of SPIDER in the first weeks of your course and information relating to SPIDER can be downloaded from http://spider.science.strath.ac.uk

# ASSESSMENT and PROGRESS

There are a variety of methods by which classes are examined and the lecturer at the start of a class should give the relevant details. You should note that **the pass mark for classes at Levels 1 - 4 is 40% and for Level 5 classes it is 50%.** Note that the credits associated with a class are indivisible. You cannot be awarded a fraction of its credits for meeting part of its requirements.

The most common assessment method is by examination. The conduct of examinations is covered by University regulations including:

1. You need to produce your student identity card at exams.
2. You are forbidden to have with you in the exam room notes of any sort unless the exam instructions explicitly permit them. [Possession of such notes in the exam room is an offence, irrespective of whether use is made of them.]

In *Physics* examinations note that for the same reason you must not take into the exam graphic calculators with memory bank facilities, and in particular, no calculator with alphabetic input. (In *Physics* and *Mathematics* exams, *programmable* calculators are forbidden. Other Departments may have other special restrictions for their examinations.)

## PLAGIARISM

Please see the University Handbook for guidelines on plagiarism. If you are unsure of any aspect of this, please contact the department.

## EXAMINATION ATTEMPTS

All students will be entitled to TWO attempts only to gain the credits for any class. These attempts will normally comprise the First Attempt taken in either the January or the June Diet of Examinations and the Second Attempt taken in the August re-sit Diet of Examinations. For some classes, such as Practical classes or classes with significant elements of continuous assessment, both attempts may take place during the 1st and 2nd semesters. It is the lecturer's responsibility to outline the assessment procedure for the class at the start of the course.

## TARGETS

You should aim to obtain the credits for all your classes because progress to later years of the course and the award of the degree depend on your cumulative total.

In brief for the progression requirements for the various degrees are summarised in the table below but full details can be found at http://phys.strath.ac.uk/undergraduate/handbook

**FOR THE MPhys DEGREE YOU MUST ACHIEVE AN APPROVED STANDARD OF PERFORMANCE WITH REGARDS TO LEVEL OF STUDY AND ACADEMIC ACHIEVEMENT.**

**THE DEPARTMENT DEFINES THIS LEVEL AS A CREDIT-MARK AVERAGE OF BETTER THAN 50% FOR EACH YEAR OF STUDY.**

## Progression Requirements

| | 1st Year to 2nd Year |
|---|---|
| **Degree** | **Credit Requirements** |
| All BSc (Hons) Physics degrees | In order to progress to the second year of any Honours degree course, a student must normally have accumulated at least 100 credits from the course curriculum. |
| MPhys degree | At all stages of the course, a student must have achieved an approved standard of performance with regard to level of study and academic attainment.<br><br>In order to progress to the second year of the course, a student must normally have accumulated at least 100 credits from the course curriculum. |

The Honours degrees are classified into four grades, Class I (a "First"), Class II(i) (an "upper Second"), Class II(ii) (a "lower Second") and a Class III (a third).

MPhys degrees require an extra year of study and are classified as for BSc Honours degrees, except there is no Class III.

Students who fail to qualify for a degree may be eligible for the award of the Diploma or Certificate of Higher Education.

## EXAMINATION BOARD DECISIONS

Whichever method of assessment is used an Examination Board will consider the results of your examinations. The Board meets first in June and also, to consider the results of August re-sit examinations, in September. The Boards of Examiners will take one of the following decisions which will then be notified to you by letter as well as by PEGASUS. (Make sure the University has your current address.) Whether you progress from one year to the next is determined by your performance in the examination diets. The University operates a Compensation Scheme, details can be found at http://tinyurl.com/phys-compscheme

### PASS

This means that you have passed in all the examinations in your curriculum, and that you are free to progress to the next year of your degree course without any resit examinations.

### MAY PROCEED

This means that although you have not passed in all of your examinations, you have obtained enough passes to go on to the next year of your course. This will apply only after the resit diet of examinations.

### RESIT

This decision indicates that you have to resit and pass the examination(s) in the class or classes specified before you can be permitted to proceed to the next year of your course. Only the first attempt is normally permitted in the Final Honours examinations.

### DO NOT PROCEED (SUSPEND)

If by the September Examination Board you have not satisfied the progress regulations, your registration will be suspended and you will not be permitted to attend classes for the following session. Instead, you must first resit and pass in enough classes in order to be allowed to continue on your course of study.

### TRANSFER

A student who does not meet the requirements for progress on a degree course may be required to transfer to the corresponding degree in the subject

### WITHDRAW

A student whose performance is considered to be so bad that none of the above alternative decisions would be appropriate will be required by the Examination Board to withdraw from his or her present degree course.

Students who are suspended or required to withdraw from Honours courses will receive details of the BSc degree course in Natural Sciences. Many students have transferred to this degree after failing to meet the progress requirements of the course of their first choice, and have then succeeded in completing a course more appropriate to their needs.

Alternatively, it may be feasible to transfer to an alternative course in a subject that is more closely aligned to your present career intentions.

## ERASMUS SCHEME

### Student Exchange Abroad

The Department has exchange agreements with a number of Universities in Europe, in Austria, Germany, France, Poland, and Switzerland that allow students to spend up to a year studying abroad during their 3rd or 4th year. There are many benefits to studying abroad, from help with foreign language skills to enhancing your CV. You can find more information on the scheme at the Erasmus website http://www.britishcouncil.org/erasmus-benefits.htm. Keep an eye on the notice boards outside Dr Papoff's office on the 8th Floor for news.

If you are interested and would like to know more, see Dr F. Papoff before November. The number of such places is limited and preference is given to those whose academic progress suggests they will benefit from the extra challenge of study abroad.

### PRIZES

A number of prizes are given at the end of each year of each course. The value of the prizes is usually quite modest: they are intended only as an incentive and encouragement as you work towards your degree. Details of the prizes can be found at http://phys.strath.ac.uk/undergraduate/handbook.

### ABSENCE

Please refer to the University Handbook for guidance on absence policy and procedures.

### MOVING HOME?

It is important to keep **both** the University Registry and the Department informed of **any change in your address**, else important information (like examination and graduation information) might go astray. Change of Address forms are available from the Student Office, JA 8.31. Please always advise the Department of any change of address, that way you can ensure that we keep our records up to date.

### DIFFICULTIES

If you find yourself with a problem or in difficulty the University has people and procedures in place to help (please refer to the University Handbook for contact details of all the main University services) but within the department help is also available. You can go and see your counsellor or adviser in the first instance. Do not delay getting help as often the problems are much reduced if tackled early enough. If they cannot give help themselves, they will often know of others who can help.

See Appendix and http://phys.strath.ac.uk/undergrad/classes.php for Class Descriptors.

# SAFETY

Safety is YOUR business and responsibility at all times. These notes supplement the Department's Safety Regulations and should be read carefully.

**Potential hazards in physics laboratories** include fire, electrical, materials and chemicals, machinery, gas cylinders, "common" accidents, ionizing radiation, laser UV, and microwave radiation. Special precautions are necessary for work on the roof of the John Anderson Building.

### Fire

Unlikely but potentially fatal to many people if it should happen. No smoking in labs. Do not let waste paper accumulate. Do not leave gas burners on unattended. Electrical equipment, especially older power supplies can go on fire if short circuited and wrongly fused. Rotary pump motors can seize (i.e. jam) and go on fire if not properly protected. In general switch off unattended equipment unless there is a good reason for leaving it on. Know where the fire exits are.

### Electrical

Current through heart stops operation of heart. Use safety equipment (see below). When adjusting equipment keep one hand away from equipment and away from any earthed conductor. This reduces current through heart from two-handed contact from 'live' to 'earth'. Know about resuscitation procedures - see notices displayed in every lab.

- Mains operated equipment including 5V power supplies, desk lamps etc.: Safety depends on correct wiring of plug, good quality cable, right fuse, proper earthing. "Tingly feeling" in finger when touching equipment indicates that it is not earthed properly. Report defects to demonstrator or lab technician - do not leave it for someone else.

- High voltage capacitor banks are very dangerous. Lethal charge is stored long after power supply switched off if fault occurs in protection circuits. Safety depends on good insulation and safety checks before alteration or maintenance (forbidden to students).

- Any high voltage equipment. "Tracking" occurs across surface of insulator. High voltage can then appear at unexpected places. Switch off power supply when altering circuit.

- Darkroom equipment - e.g. safety lights, driers etc. Dangerous because the darkroom is usually small, badly lit and wet (you are well earthed and hence at risk).

### Materials and chemicals

- Many common chemicals and solvents are toxic - cancer an important risk, e.g. Benzene, Carbon Tetrachloride, Chloroform. Good ventilation important. Tap water is not necessarily drinking water.
- Many solvents are inflammable - especially Benzene.

- Do not tip solvents down sink unless it is certain they will do no harm.

- Unless you have good knowledge of chemistry, do not mix chemicals without first getting expert advice.

- Alkali metals (e.g. sodium, potassium) react explosively with water.

- Mercury fumes are poisonous. If mercury gets spilled, inform demonstrator.

- Liquid nitrogen is cold but causes burns. Make sure it cannot splash into your eyes or onto your clothing.

- Asbestos fibres can lodge in lungs - cancer years later. Be cautious with asbestos and seek advice (there shouldn't be any asbestos in the lab).

- Many chemicals can cause dermatitis or other skin ailments (some people more susceptible than others). Keep your hands away from chemicals (gloves available if needed). Wash your hands if they should come into contact with chemicals of any sort.

- In general - do not eat in labs. Wash hands after leaving lab and before eating. Label all containers of chemicals and never use lemonade or similar bottles to store chemicals in.

**Machinery**

- In lab, rotary pumps have powerful electric motor with drive belt. Belt guard is not infallible protection against long hair or tie being caught up in belt. Fans on diffusion pumps are also a hazard.

- In machine shop - get expert advice. You should not use machines without supervision.

**Gas cylinders**

Contain gas at high pressure (~ 200 atmospheres). If a cylinder topples over, the danger results from its large weight and from the possibility that the cylinder neck may fracture (ejecting the valve). Gas cylinders should be secured to wall. Two valves to operate - get advice from demonstrator the first time you use one.

**"Common" accidents** e.g. falling down stairs, tripping over obstacles etc. Keep passageways clear of obstacles (e.g. bench stools, books, unused equipment) - especially in darkened labs. No horseplay in labs.

**Radioactive** or X-ray sources are covered by special rules. They must not be used without an approved scheme of work signed by the Department Radiation Protection Advisor.

**Lasers** are divided into classes:

| | |
|---|---|
| 1 | Harmless |
| 2 or 3A | Low power but precautions needed |
| 3B | Medium power - severe eye damage possible |
| 4 | Severe eye and skin damage possible |

Before using any laser other than a class 1 you must have permission from your Supervisor who will arrange for an approved scheme of work signed by the Departmental Radiation Supervisor.

**Roof of the John Anderson Building** – You are forbidden to go onto the roof unless you have permission in writing from your Project Supervisor. He will tell you the current procedures.

Finally your first accident may be one we have not thought of yet. So be careful.

*We believe the information provided in this handbook is correct at the date of publishing but may be subject to revision.*

N.B. THIS HANDBOOK CAN BE SUPPLIED IN A VARIETY OF FORMATS TO SUIT YOUR NEEDS. PLEASE CONTACT THE DEPARTMENT FOR MORE INFORMATION

# APPENDIX – CLASS DESCRIPTORS

**FACULTY OF SCIENCE**

**CLASS DESCRIPTOR**

PH 150 Experimental Physics

| | | | |
|---|---|---|---|
| **Class Code:** PH 150 | | **Class Name:** Experimental Physics | |
| **Type:** Compulsory | **Level:** 1 | **Credits:** 20 | **Semester:** 1 and 2 |
| **Class Coordinator:** Dr N. Langford | | **Tel:** 3077 | **Email:** n.langford@strath.ac.uk |
| **Teaching Staff:** Dr N. Langford, Dr I. S. Ruddock | | | |
| **Pre-requisites:** Higher Physics and Mathematics or equivalents | | | |

**CLASS DELIVERY (HOURS):**

| LECTURES | TUTORIALS | LABORATORIES | ASSIGNMENTS | SELF STUDY | TOTAL |
|---|---|---|---|---|---|
| 12 | | 60 | 20 | 108 | 200 |

**CLASS ASSESSMENT**

**Format:** Continuous Assessment

**1st Attempt:** Laboratory work 50 %, Formal Report 50 %

**Re-sit:** Re-draft of Formal Report – Pass / Fail

**GENERAL AIMS**

To develop students ability to work in a laboratory environment

**LEARNING OUTCOMES**

At the end of the course students should be able to

1. Be able to keep a laboratory notebook.
2. Be able to write a Formal Report.
3. Be able to perform simple uncertainty analysis.
4. Be able to make dimensional analysis of physical systems.

**SYLLABUS**

Lecture based material

- What is and why undertake an experiment; physical quantities; dimensional analysis; units of measurement; order of magnitude estimates; accuracy and precision; uncertainty analysis; use of Excel for determining uncertainties; report writing.

Laboratory based work

- Preliminary experiments to develop measurements skills / techniques – simple pendulum, viscosity of a fluid, RC time constant, use of Excel, density of steel.
- Advanced experiments to support 1st Year lecture material – magnetic induction, geometric optics, refraction, atomic spectroscopy, acoustic resonances, standing waves on a string, angular momentum, charge to mass ratio of an electron, dc circuits, Young's modulus.

**RECOMMENDED TEXT / READING**

Squires Practical Physics 3rd Edition ISBN:-, Benson – University Physics

**DATE MODIFIED**

15th August 2008 N. Langford

**FACULTY OF SCIENCE**

**CLASS DESCRIPTOR**

PH 151 Mechanics, Optics and Waves

| | | | |
|---|---|---|---|
| **Class Code:** PH 151 | | **Class Name:** Mechanics, Optics and Waves | |
| **Type:** Compulsory, Elective | **Level:** 1 | **Credits:** 20 | **Semester:** 1 |
| **Class Coordinator:** Dr N. Langford | | **Tel:** 3077 | **Email:** n.langford@strath.ac.uk |
| **Teaching Staff:** Dr N. Langford | | | |
| **Pre-requisites:** Higher Physics and Mathematics or equivalents | | | |

**CLASS DELIVERY (HOURS):**

| LECTURES | TUTORIALS | LABORATORIES | ASSIGNMENTS | SELF STUDY | TOTAL |
|---|---|---|---|---|---|
| 48 | 24 | | 24 | 104 | 200 |

**CLASS ASSESSMENT**

**Format:** Continuous and Examination

**1st Attempt:** Students will be awarded the credit for the class by either (a) performance at an approved standard in Class Tests or (b) taking the Written Examination

Break down of assessment:

By (a) Class Test 85 %, Homework 15 %

By (b) Examination 70 %, Class Test 15 %, Homework 15 %

**Re-sit:** Re-working of 1st attempt examination Pass / Fail

**GENERAL AIMS**

Provide students with an understanding of motion of simple mechanical systems, the fundamentals of wave propagation and simple optical phenomena.

**LEARNING OUTCOMES**

By the end of the course a student shall show

1. Ability to analysis the motion of a particle in two dimensions.
2. Ability to apply Newton's three laws to analysis bodies in different conditions.
3. Ability to explain difference between elastic and inelastic collisions.
4. Ability to address problems on conservation of linear momentum.
5. To understand circular motion .
6. State and apply Newton's Law of Gravity, determine gravitational field strength at a given point.
7. Know the difference between conservative and dissipative forces, work and power.
8. Ability to apply kinematic equations to angular motion and associated rotational forces.
9. To describe conditions necessary for a body to execute simple harmonic motion and determine displacement, velocity and acceleration of body.
10. Define a wave, differentiate between wave types .
11. Identify key parameters associated with harmonic / periodic waves and use different notations to describe wave.
12. Differentiate between travelling and standing waves and write down equations for each type of wave – identify conditions necessary for node and anti-nodes.
13. Understand difference between particle and wave velocity.
14. Explain reflection and transmission of mechanical waves at a boundary.

15. State and apply principle of linear superposition to waves – beats and interference.
16. Understand effect of relative motion between wave source and detector- Doppler Effect.
17. Understand and apply Huygens' Principle to reflection, refraction and diffraction.
18. Explain the concepts of critical angle and total internal reflection

**SYLLABUS**

**Mechanics:**

- Motion in 1 dimension: Definitions of velocity and acceleration, equations of motion for constant acceleration.
- Vectors: Addition of vectors, resolution into components, use of unit vectors. Vector multiplication, scalar and vector products.
- Motion in 2 dimensions: Motion in a plane, projectiles.
- Newton's Laws: Statements of Newton's three laws, equilibrium, statics and dynamics, friction forces.
- Linear momentum: Centre of mass, conservation of linear momentum. Impulse and momentum, elastic and inelastic collisions.
- Uniform circular motion: Angular speed, centripetal acceleration, examples of uniform circular motion.
- Work and Energy: Mechanical work, kinetic and potential energy. Conservative and dissipative forces. Gravitational and Elastic Potential Energy functions. Conservation of mechanical energy. Energy and Power.
- Gravitation: Newton's law of gravitation, gravitational field strength (g) and variation with altitude. Motion of satellites.
- Simple Harmonic Motion: Defining equation and its solution. Meaning of amplitude, angular frequency and phase constant. Forces producing simple harmonic motion.
- Rotational Mechanics: Angular velocity and angular acceleration. Kinematic equations for rotation with constant angular acceleration. Moment (Torque) of a force about a point and relationship to angular acceleration. Moment of inertia of systems of particles and rigid bodies. Rotational kinetic energy. Angular Momentum.

**Waves**

- Wave fundamentals**:** Definition of a wave. Types of wave Frames of reference, wave function $y(x,t) = f(x-vt)$, speed of wave, phase of wave.
- Periodic Waves. Definition of wavelength and period. Harmonic waves and $\omega$-k notation, initial phase $\phi$ and phase differences. Difference between wave speed and particle speed. Particle velocity and acceleration. Wave speed on a string. Energy transport by a wave on a string.
- Principle of linear superposition. Reflection at free and fixed ends, reflections at interfaces. Resonant waves on strings and in open and closed pipes. Standing waves. Beats. Interference and coherence
- Waves in more than one dimension, circular and spherical waves, energy conservation in spherical waves. Huygens' Principle.

**Optics:**

- Idea of electromagnetic (em) waves. Speed of light in vacuum. Huygens' principle applied to reflection, refraction and diffraction. Laws of reflection. Diffuse and specular reflections.
- Images: Introduction to real and imaginary images and objects. Deviation introduced by reflection. Image formation in plane mirrors.
- Refraction in materials. Speed of light in a material. Snell's law. Deviation induced by refraction. Critical angle and total internal reflection. Optical fibres. Refraction in prisms. Minimum deviation in a prism.

**RECOMMENDED TEXT / READING**

Harris Benson University Physics ISBN

**DATE MODIFIED**

15th August 2008 by N. Langford

**FACULTY OF SCIENCE**

**CLASS DESCRIPTOR**

PH 152 Quantum Physics and Electromagnetism

| | | | |
|---|---|---|---|
| **Class Code:** PH 152 | | **Class Name:** Quantum Physics and Electromagnetism | |
| **Type:** Compulsory, Elective | **Level:** 1 | **Credits:** 20 | **Semester:** 2 |
| **Class Coordinator:** Dr N. Langford | | **Tel:** 3077 | **Email:** n.langford@strath.ac.uk |
| **Teaching Staff:** Dr I. S. Ruddock, Dr A. Arnold | | | |
| **Pre-requisites:** Higher Physics and Mathematics or equivalents | | | |

**CLASS DELIVERY (HOURS):**

| LECTURES | TUTORIALS | LABORATORIES | ASSIGNMENTS | SELF STUDY | TOTAL |
|---|---|---|---|---|---|
| 48 | 24 | | 24 | 104 | 200 |

**CLASS ASSESSMENT**

**Format:** Continuous and Examination

**1st Attempt:** Students will be awarded the credit for the class by either (a) performance at an approved standard in Class Tests or (b) taking the Written Examination

Break down of assessment:

By (a) Class Test 85 %, Homework 15 %

By (b) Examination 70 %, Class Test 15 %, Homework 15 %

**Re-sit:** Re-working of 1st attempt examination Pass / Fail

**GENERAL AIMS**

This class is designed to provide the students with an introduction to quantum physics and electromagnetism.

**LEARNING OUTCOMES**

1. Ability to define and apply Coulomb's Law to determine electrostatic force acting between charges.
2. Ability to determine electric field associated with charges.
3. Ability to describe and analyse motion of charges in electric fields.
4. Ability to find the electrostatic potential associated with a set of charges.
5. Know that capacitors store charge and how to analyse networks of capacitors.
6. Understand the difference between current and current density.
7. Be able to apply Ohm's Law and Kirchoff's Rules to DC circuits.
8. Be able to determine the magnetic field for various systems and understand the motion of charged particles in a magnetic field.
9. Ability to determine force on a conductor and the torque on a current loop.
10. Understand photoelectric effect and determine stopping potential and work function.
11. Apply Bohr model of atom to obtain atomic energy levels and understand origin of spectral lines for atomic transitions.
12. Understand the origin of the Pauli exclusion principle and its consequences for atomic systems.
13. Understand wave-particle duality and apply Heisenberg's uncertainty principle.
14. Be able to determine nuclear binding energy.
15. Ability to explain difference between fusion and fission .
16. Ability to classify and distinguish between fundamental elementary particles.

**SYLLABUS**

**Electromagnetism:**

- Charge, electrostatic forces, Coulomb's Law. Electric field E, lines of force. Fields in conductors. Motion of free charges. Electric flux, Electric potential energy, electric potential V.
- Electric potential V for uniform electric fields and point charges. The electron volt. Equipotentials.
- Capacitance, series/parallel networks of capacitors, stored energy. Dielectrics, dielectric strength.
- DC Circuits: Electric current, current density. Resistivity, conductivity, temperature dependence, resistance, conductors, insulators. Ohm's Law. Electrical power and work. Conduction at an atomic level. Electromotive force, internal resistance. Kirchoff's Rules. Resistors in series and parallel, RC circuits. Instruments.
- Magnetism and Magnetic Effects: Magnetic field B, forces on charges and conductors. Force and torque on current loops; magnetic dipoles. Magnetic devices; mass spectrometer. Hall effect. B for a long wire, solenoid, toroid, Forces between parallel wires.

**Quantum Mechanics:**

- Atomic & Quantum Physics: Blackbody radiation, light quanta and the photoelectric effect, atomic spectra, the Bohr model of the atom, lasers, electron diffraction, the wave equation and the Heisenberg uncertainty principle, Pauli exclusion principle.
- Nuclear Physics: Isotopes, binding energy and nuclear stability, radioactivity, carbon dating, nuclear reactions, fission and fusion, nuclear reactors.
- Elementary Particles: Forces of nature, quantum field theory, classification of particles. Properties of leptons, hadrons, baryons, fermions, bosons and quarks.

**RECOMMENDED TEXT / READING**

Harris Benson; University Physics ISBN

**DATE MODIFIED**

15th August 2008 by N. Langford

**FACULTY OF SCIENCE**

**CLASS DESCRIPTOR**

**DEPARTMENT OF MATHEMATICS & STATISTICS**

| | | | | |
|---|---|---|---|---|
| **Class Code:** **MM111** | | **Class Title:** **Mathematics 1B** | | |
| **Type:** **UG** **Elective** | **Level:** **1** | **Credits:** | **20** | **Semester:** **1** |
| **Class Coordinator:** | | **Tel:** | **Email:** | |
| **Teaching Staff:** | | | | |
| **Pre-requisites:** SQA Higher Mathematics (grade B) or equivalent | | | | |
| **Students:** Chemical Engineering, Naval Arch & Marine Engineering, Physics | | | | |
| **Overlaps:** MM110, MM113, MM115, MM116, MM117, MM101, MM103, MA101, MA102, MA108, MA11x | | | | |

**CLASS DELIVERY (HOURS)**

| LECTURES | TUTORIALS | LABORATORIES | ASSIGNMENTS | SELF STUDY | TOTAL |
|---|---|---|---|---|---|
| 48 | 24 | 0 | 36 | 92 | 200 |

**CLASS ASSESSMENT**

2 hour degree examination in January with August resit. Exemption from degree examination is possible based upon performance in class tests.

**GENERAL AIMS**

To give a basic understanding of the concepts and applications of mathematical functions, differentiation, integration and complex numbers.

**LEARNING OUTCOMES**

On completion of this class, the student should

- understand the concept of a mathematical function;
- be familiar with commonly occurring functions and their properties, and be able to manipulate and solve equations and inequalities involving them;
- know the factorial and binomial coefficient notation, and be able to use the binomial theorem;
- be able to differentiate functions, via combinations of the various differentiation rules;
- be able to locate and classify stationary points of a function of one variable;
- be able to integrate simple functions;
- be able to manipulate complex numbers in Cartesian, polar and exponential form;
- be able to use De Moivre's Theorem to find all zeros of a polynomial and obtain trigonometric identities.

**SYLLABUS**

**Mathematical Foundations:**

Algebra – mathematical notation, number sets and inequalities, basic operations (+,–,×,÷), modulus, factorial, indices, rules of precedence, use of brackets, expanding brackets, binomial expansion, simplifying algebraic expressions, factorisation, common denominators, cancelling common factors, proportionality, mathematical formulae and transposition, partial fractions.

Functions – basic concepts and notation, graphs, continuity and limits; composition of functions; inverses; linear and quadratic functions, completing the square; other commonly occurring functions (including polynomials, rational functions, exponentials, logarithms, hyperbolic functions, modulus); odd and even functions; periodic functions.

Solving equations – linear equations, quadratic equations, polynomial equations; simultaneous equations in two unknowns.

Trigonometry – definitions and graphs of sine, cosine and tangent; periodicity; radian measure; definitions of sec, cosec and cot, and of inverse trigonometric functions; important trigonometric identities; solving trigonometric equations.

**Introduction to Calculus:**

Differentiation – definition of a derivative; notation; simple examples from first principles; graphical interpretation; stationary points; higher derivatives.

Standard derivatives – including x^a and trigonometric, exponential and natural log functions.

Rules of differentiation – linearity; product rule; quotient rule; chain rule.

Indefinite integration – reversing differentiation; standard integrals; linearity.

Definite integration – motivation: area under a curve; definition; the Fundamental Theorem of Calculus; finite and infinite limits.

**Complex Numbers:**

Algebra of complex numbers – motivation and definition of i; real and imaginary parts; arithmetic of complex numbers.

Polar and exponential forms – the Argand diagram; modulus and argument; polar form; Euler's formula; exponential form; products and quotients in exponential form.

De Moivre's Theorem – De Moivre's theorem; nth roots; solving polynomial equations; trigonometric identities.

Transferable Skills: See Level 1S spreadsheet for details.

**RECOMMENDED TEXT / READING**

** Croft, A. & Davison, R. *"Mathematics for Engineers, A Modern Interactive Approach"* 2nd Edition. (Pearson) ISBN: 013120193X.

**DATE MODIFIED:** 14 June 2009

**FACULTY OF SCIENCE**

**CLASS DESCRIPTOR**

**DEPARTMENT OF MATHEMATICS & STATISTICS**

| | | | | |
|---|---|---|---|---|
| **Class Code:** **MM112** | | **Class Title:** **Mathematics 2B** | | |
| **Type:** **UG** **Elective** | **Level:** **1** | **Credits:** | **20** | **Semester:** **2** |
| **Class Coordinator:** | | **Tel:** | **Email:** | |
| **Teaching Staff:** | | | | |
| **Pre-requisites:** MM111 or equivalent, MA111 or equivalent | | | | |
| **Students:** Chemical Engineering, Naval Arch & Marine Engineering, Physics | | | | |
| **Overlaps:** MM101, MM102, MM103, MM110, MM114, MM115, MM116, MM117, MA101, MA102, MA107, MA108, MA11x | | | | |

**CLASS DELIVERY (HOURS)**

| LECTURES | TUTORIALS | LABORATORIES | ASSIGNMENTS | SELF STUDY | TOTAL |
|---|---|---|---|---|---|
| 48 | 24 | 0 | 36 | 92 | 200 |

**CLASS ASSESSMENT**

2 hour degree examination in May/June with August resit. Exemption from degree examination is possible based upon performance in class tests.

**GENERAL AIMS**

To give a basic understanding of the concepts and applications of calculus, geometry, vectors, matrices and numerical methods.

**LEARNING OUTCOMES**

On completion of this class, the student should be

- able to differentiate functions defined either implicitly or parametrically;
- able to solve practical max/min problems;
- able to find definite and indefinite integrals using substitutions, partial fractions and integration by parts;
- able to use integration to calculate the area between two curves, volumes of solids of revolution, and lengths of planar curves;
- familiar with the equations of a straight line and a circle in 2 dimensions;
- familiar with the concept of a vector and the fundamental operations with vectors: addition, multiplication by a scalar, and scalar and vector products;
- able to find and use equations for lines and planes in 3 dimensions;
- able to carry out standard matrix operations;
- able to express systems of linear equations in matrix form, and to apply elementary row operations on the associated augmented matrix to find the solution of a given system;
- able to use the Trapezoidal/Simpson's Rule to approximate a definite integral;
- able to use Newton's method to find a root of a nonlinear equation (e.g. a polynomial or trig. equation).

**SYLLABUS**

**Further Calculus:**

Implicit differentiation – first derivatives and simple cases of second derivatives; derivatives of inverse trigonometric functions.

Parametric differentiation – first derivatives and simple cases of second derivatives.

Applications – graph sketching; optimisation problems; related rates of change; linear approximation and error analysis; simple Taylor and Maclaurin series.

Methods of integration – integration by substitution; integration by parts; integration using partial fractions; integrals of some trigonometric functions.

Applications – area between two curves; volumes of revolution about x and y axes; arc length of a plane curve.

**Geometry and Vectors:**

2-D geometry – Cartesian coordinates and polar coordinates; distance formula; equations of lines and circles; intersection of lines.

Vectors – motivation: quantities having magnitude and direction, e.g. force, velocity, displacement, etc; vectors as directed line segments; vector algebra; orthogonal unit vectors; representation of vectors as number triples; scalar and vector products, with applications.

3-D geometry – equation of a line through two points or through a point in a given direction; intersection of lines; equation of a plane through three points or through a point with a given normal vector; intersection of a line and a plane.

**Matrices and Systems of Linear Equations:**

Matrix algebra – definitions, notation, and some special matrices; multiplication by a constant; addition of matrices; matrix multiplication.

Matrix inverse – definition of the inverse of a square matrix, examples; the inverse of a 2 × 2 matrix; singular and non-singular matrices.

Linear equations – representation of a system of linear equations in matrix form.

Solution of systems of linear equations – Augmented matrix for n equations in n unknowns; reduction to triangular form using elementary row operations; unique solution, non-uniqueness and inconsistency.

**Numerical Methods:**

Numerical integration – Trapezoidal rule, Simpson's Rule.

Numerical solution of non-linear equations – Newton's method.

Transferable Skills: See Level 1S spreadsheet for details.

**RECOMMENDED TEXT / READING**

** Croft, A. & Davison, R. *"Mathematics for Engineers, A Modern Interactive Approach"* 2nd Edition. (Pearson) ISBN: 013120193X.

**DATE MODIFIED:** 14 June 2009