STAGE 2
STAGE 3
STAGE 4
PROGRAMMES

2007/2008

SCHOOL OF
PHYSICAL SCIENCES

KENT
UNIVERSITY OF KENT

UNIVERSITY OF KENT

FACULTY OF SCIENCE, TECHNOLOGY AND MEDICAL STUDIES

SCHOOL OF PHYSICAL SCIENCES

STAGE 2, STAGE 3 & STAGE 4 HANDBOOK 2007/2008

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UNIVERSITY OF KENT

FACULTY OF SCIENCE, TECHNOLOGY AND MEDICAL STUDIES

SCHOOL OF PHYSICAL SCIENCES

STAGE 2, STAGE 3 and STAGE 4 HANDBOOK 2007/2008

Welcome to Stage 2, 3 and 4. This handbook contains most of the details that you will need about the running of Stage 2, 3 and 4 and the courses you will take.

Section A contains general information about the department, points of contact, timetables and the year abroad;
Section B lists the module requirements for each degree and provides a catalogue of all the modules available for students undertaking Stage 2, 3 and 4 of any of our Physics or Forensic Science degrees;
Section C contains more detailed information about regulations for attendance at classes and examination requirements;
Section D contains information about support services provided centrally by the University; and
Section E contains lists of teaching and staff room locations to help you around the campus and department.

Please note that the information presented in this booklet is given according to the current state of knowledge. The School of Physical Sciences may, at its discretion, introduce changes in the course or examination structure (including the addition, withdrawal or restructuring of courses) and any significant variation from that presented here will be announced and displayed on the notice boards.

SECTION A: GENERAL INFORMATION

A1. 2007/2008 TERM DATES

Autumn Term	-	24th September 2007 – 14th December 2007 (Weeks 1-12)
Spring Term	-	14th January 2008 – 4 April 2008 (Weeks 13-24)
Summer Term	-	5 May 2008 – 13 June 2008 (Weeks 25-30)

Good Friday is 21 March 2008 and Easter Monday 24 March 2008; May Bank Holidays are Monday 5th May 2008 and Monday 26th May 2008. There will be no teaching or examinations on these dates.

A2. THE FIRST FEW DAYS

CONTACT POINTS

Departmental information will be transmitted to you via one or more of the following, which you should check frequently:

Pigeon holes - in the student study room on the ground floor of the department (G48).

Notice boards - in the student study room on the ground floor of the department (G48).

E-mail - At registration you will be given information on using the computers on campus. You should become familiar with these as soon as possible, and log on to your Windows XP account before the first Monday of the Autumn Term if possible. This is **essential** for communication with staff and students by electronic mail (e-mail), the use of tuition software, and access to the Internet.

If you run into any problems then do let either your tutor or the Director of Undergraduate Studies know, and they will do their best to sort them out as quickly as possible.

MODULE REGISTRATION

Your modules will be registered online this year. Please report to the Departmental Administration office if your modules did not load or you think you have modules missing.

TIMETABLE

Normal teaching hours are from 9.00am - 6.00pm on Monday, Tuesday, Thursday and Friday, and 9.00am - 1.00pm on Wednesday. Students should however note that it is, on occasion, necessary for teaching to take place on Wednesday afternoon or from 6.00pm - 7.00pm on Monday, Tuesday, Thursday or Friday. Teaching takes the form of lectures, laboratory classes, examples classes, workshops and seminars. Your personal timetable is available from your pages of the Student Data System.

Any changes to these will be sent by email, from within the Student Data System.

Teaching starts at five minutes past each hour and finishes at five minutes to the hour in order to allow ample time to get from one lecture theatre to the next. A list of lecture theatre names and abbreviations is given in section G1.

CLASSES

Lists of groups for laboratory and workshop classes will be sent to you by email in the first few days of term. Please check the notice board each day to see if a list has been posted, in case you have been assigned to a class commencing on the following day. Note that if you are doing a module run by another department, information on classes etc. will be posted on their notice boards/emailed by them.

A3. WHO's WHO?

TUTORS

Every student in the School of Physical Sciences is allocated a tutor. You will find out who your year tutor is in your first few days at Kent.

The tutor is there to assist you with general advice on academic issues, and to offer pastoral support. They will also be able to direct you towards other support services available on campus. You should feel free to seek their advice whenever you are faced with a problem.

Tutors also deal with the initial stages of the disciplinary process within the School. You may be asked to attend an appointment with your tutor if you have, for example, consistently failed to submit coursework on time.

Email is the best way of contacting your tutor to make an appointment to see them. You will find a list of staff email addresses at the back of this handbook. Some tutors may also post their "office hours" on the door of their room. These are times at which the tutor is available to see tutees.

A female member of staff is usually available (by referral from the tutor) to discuss personal issues with any student who would feel more comfortable talking to her.

SENIOR TUTOR

The Senior Tutor for the School of Physical Sciences manages the Personal and Academic Support System (PASS). He/She is assisted by the tutors. The Senior Tutor has a predominantly disciplinary role. Year tutors refer students with consistently poor performance to the Senior Tutor who will often agree a *learning contract* with them, and support them as they attempt to get their studies back on track. Occasionally, the Senior Tutor may have to recommend to the Dean that a student's studies should be terminated due to lack of diligence or poor performance. Fortunately, this doesn't happen very often!

Additional and up-to-date information can be found at:
http://www.kent.ac.uk/physical-sciences/main/undergraduate/pass/index.htm

DIRECTOR OF UNDERGRADUATE STUDIES & DIRECTOR OF LEARNING AND TEACHING

Directors of Undergraduate Studies are in overall charge of all undergraduate teaching matters at a 'strategic' level, with a Director of Learning and Teaching assuming overall 'responsibility' for the undergraduate programmes offered by the entire School of Physical Sciences.
Details of the academic staff who currently hold these posts may be found on the SPS web site, but if in doubt feel free to enquire in the Student Admin Office (Room 209 on the Second Floor of the School building).

STUDENT ADMINISTRATION OFFICE

The School's Student Administration Office is located in Room 209 on the Second Floor. It is a "one-stop" shop for all student related matters. If you have any queries regarding your registration, modules, marks, intermissions or withdrawals you should go to the student admin office. Staff there will also issue you with status letters and transcripts.

Arrangements for the completion of Physics problem sheets will be advised at the start of term. Forensic Science and Forensic Chemistry problem sheets are usually issued within lectures, by the lecturer concerned; work should be handed in at the following week's lecture, or via the supervision boxes on the 2nd floor of the SPS building.

A4. <u>STUDENT SUPPORT</u>

PERSONAL ACADEMIC SUPPORT SYSTEM

Academic Advice and Progress Monitoring

SPS has established and published (both in this booklet and on its web site) a clear system of academic support and advice on progress for all its students. The academic support and advice provided by SPS ensures that students can consult a named person (often either the tutor or the administration staff) in the department on:

- Module choice and programme structure
- General academic guidance
- Academic problems/difficulties
- Progression routes
- Individual progress
- Change of module or programme
- Further/Advanced study
- Other academic issues

SPS has also established a system of monitoring student diligence and performance. Although it must remain primarily the student's responsibility to ensure that he/she contributes fully to his/her education and training by attending timetabled classes and undertaking the private study associated with them, the monitoring system helps to ensure:

- that under-performance is identified at a relatively early stage;
- ***that academic progress is monitored within each module;***
- that academic progress for each student is monitored across all modules;
- that students whose progress or diligence is not adequate, are interviewed by their tutor and subsequently, if necessary, by the Senior Tutor (who, ultimately, is able to request that the University terminates the student's registration).

References

SPS ensures that an appropriate mechanism is in place to provide references upon reasonable request (e.g. for employment after graduation). It is usual to ask your tutor to supply one of these, and often the final year project supervisor will provide a second reference; the Administration Office are able to supply "standard" letters (e.g. to provide evidence of your student status, or to contact your LEA/funding agency).
You will be responsible for completing a Personal Development Statement so that an accurate reference may be written.

Change of Address

Please inform the Administration Office (room 209, second floor) if you change your address, either in person, by email to spsadmin@kent.ac.uk or on-line in your personal pages on the Web.

Staff/Student Liaison Committee

The department has a Staff/Student Liaison committee (SSLC), which acts as a forum for the exchange of views and comments on all aspects of the department's activities. Every matter raised receives a formal reply. Elections for the student members of the committee are held early in Autumn Term, and the names of members of the SSLC and minutes of their meetings are posted on the departmental website. Students are drawn from the SSLC to participate in the main SPS decision-making bodies (the Teaching Committees and the Staff Meeting), and a student representative from each SSLC in the faculty also serves on the Faculty Learning & Teaching Committee and the Faculty Board.
The SSLC's web pages are at:
www.kent.ac.uk/physical-sciences-local/admin/staff-student-liaison/index.htm

Student study room (G48)

The department has a dedicated student study room on the ground floor of the department. The room contains a number of networked PCs, pigeonholes and noticeboards and a small collection of books and journals. Please help to keep the room tidy and in good condition for the benefit of all SPS's students.

Library

The Templeman Library contains multiple copies of all recommended text books for Physical Sciences modules. Some are included in the Short Loan Collection to allow quick access for all students.

Computing facilities

All undergraduate students are provided with a login to one or more servers on the campus network. These provide a range of facilities including electronic mail, access to the world wide web, word processing, spreadsheet and display software, in addition to a range of more specialised packages. Computers are an essential tool for scientists, for communication, data analysis and scientific programming, and tuition is provided as an integral part of the courses offered in the department. Networked PCs or terminals can be found in the department's student study room and laboratories, the colleges, library and computing centre. Instructions on access to all computing services, email, the world wide web and commonly used software is provided in the "Student Resource Book" provided by the University Computing Service.

e-mail

Please note that e-mail has become one of our primary routes for communication within SPS; as an integral part of our continuing move towards the "electronic office" environment it is regarded as your individual responsibility to check your e-mail <u>at least</u> once every day, to ensure that the 'inbox' has sufficient free space to allow for the reception of e-mails and documentary attachments. It is strongly suggested that you try to provide a <u>minimum</u> of 1 Mb of space within your 'inbox' at any one time (- although the mail server will make a small number of repeated attempts to send a message to you if your inbox is overly full, so you have a few days leeway before the incoming message would be lost). The serious consequence of failing to do this is that you will miss important notices (e.g. regarding lecture venue changes, coursework submission requirements, etc.).

Please note that we regard a failure to read, and where necessary respond to e-mail communications as evidence of a lack of diligence – it can therefore be used as such within any disciplinary process that may arise.

School of Physical Sciences website

The website contains a range of information about the department, course material, specimen examination papers, research and minutes of relevant meetings such as those of the Staff-Student Liaison Committee. It can be found at http://www.kent.ac.uk/physical-sciences/ .

A5. <u>THE YEAR ABROAD</u>

Physics degree programmes within the School of Physical Sciences allow the possibility of studying for one year at a University in the USA. Physics degrees with a year in the USA are offered at MPhys level only.
These degrees enable you to experience the teaching of another institute and to learn something of the culture of another country. This option is not currently available for forensic science degrees due to the lack of suitable courses at Universities abroad.

The year abroad is a challenging and often a very enriching experience but should not be attempted without a clear motivation and recognition of possible problems at both the academic and personal level.

The year abroad is the 3rd year of a 4-yr programme. You therefore follow the normal pattern of modules in the first two years. You will need to discuss the arrangements with the Physics Director of Undergraduate Studies during the Autumn term of the 2nd year. The contacts for exchanges are made directly by the University's International office in consultation with the Physics co-ordinator of the overseas university to establish a suitable programme of study. You must inform your LEA and complete any required documentation.

Progression on degree programmes with studies abroad requires achievement of a minimum level of achievement at Stage 2. This threshold is currently set at 55% for M.Phys. degrees. The confirmation of the exchange can only be made after the 2nd year exam results are available and the appropriate thresholds achieved (see Section C2).

During the year abroad, you will attend the required courses and sit the exams set by that institution, just as if you were a student there. On return to the UK, you are required to write a report on the work done abroad and review the overall experience. This document and the exam results form the basis for an assessment mark to be decided for the 3rd year of the degree programme.

The final year is spent at Kent and involves Stage 3 or 4 modules leading to a MPhys degree.

The mark from the year abroad counts 20% of the overall degree assessment. The marks are otherwise compiled with the same weighting as for the normal degrees. The complete weightings are listed in Section C2. The awarded degrees have titles carrying a specific indication of the year spent studying abroad.

A6. THE YEAR IN INDUSTRY

If you are registered for the BSc in Forensic Science with a year in industry, or a BSc in Forensic Chemistry with a year in Industry, your third year is spent on an industrial placement working on some aspect of research and development. Placements are competitive. They should be arranged by the student early in the second year in consultation with their tutor and the industrial placement coordinator.

Assessment of the year in Industry is by a written report, oral presentation and industrial supervisor's assessment. Your tutor will visit you during the year to assess progress. The mark from the industrial placement counts 20% of the overall degree assessment. The complete weightings are listed in Section C2.

SECTION B: CATALOGUE OF MODULES

B1. MODULE REQUIREMENTS

Each degree programme is modular and you must take modules totalling 120 credits at each stage. Modules consist of multiples of 15 credits. You will take all core modules and one or more option modules. Each module has a code consisting of two letters followed by three digits. In some cases timetable constraints may affect which options can be taken.

Each degree programme has a unique code used by the University for all records. These are listed below together with short codes that are used in the handbook and also often found in communications from departmental staff:

FORENSIC SCIENCE DEGREES

Single honours Forensic Science degrees are available as a BSc and can involve a year in industry. Where the degree includes a year away from Kent the third year is spent away and the period of study is always four years (see section A6 for further details).

University code	Short code	Degree Programme
FORENSIC:BSC	FS	Forensic Science BSc
FORENSIC-S:BSC	FS(I)	Forensic Science with a year in Industry BSc
FORENSIC/CHEM:BSC	FC	Forensic Chemistry BSc
FORENSIC/CHEM-S:BSC	FC(I)	Forensic Chemistry with ayear in Industry BSc

Table 1 details the modules to be taken at Stage 2 of all BSc degrees
Table 3 details the modules to be taken at Stage 3 of all BSc degrees

PHYSICS DEGREES

Single honours Physics degrees are available as either a BSc or MPhys, and can involve a year abroad in the USA. Where the degree includes a year away from Kent the third year is spent away and the period of study is always four years (see section A5 for further details).

The following codes are used in this handbook to signify the available Physics degrees:

University code	Short code	Degree Programme
PHYS:BSC	P	Physics BSc
PHYS-4:MPHYS	MP	Physics MPhys
PHYSAM-A:MPHYS	MP(U)	Physics with a year in the USA MPhys
PHYS/ASTRO:BSC	PA	Physics with Astrophysics BSc
PHYS/ASTRO-4:MPHYS	MPA	Physics with Astrophysics MPhys
PHYS/ASTROUS-A:MPHYS	MPA(U)	Physics with Astrophysics with a year in the USA MPhys
PHYSSSS:BSC	PSS	Physics with Space Science and Systems BSc
PHYSSSS-4:MPHYS	MPSS	Physics with Space Science and Systems MPhys
PHYSSSSAM-A:MPHYS	MPSS(U)	Physics with Space Science and Systems with a year in the USA MPhys
ASSA:BSC	ASSA	Astronomy, Space Science & Astrophysics BSc
ASSA-4:MPHYS	MASSA	Astronomy, Space Science & Astrophysics MPhys
ASSA-A:MPHYS	MASSA(U)	Astronomy, Space Science & Astrophysics with a year in the USA MPhys
PHYS/FORENSIC:BSC	PFS	Physics with Forensic Science

Table 2 details the modules to be taken at Stage 2 of all BSc and MPhys degrees.
Table 4 details the modules to be taken at Stage 3 of all BSc and MPhys degrees
Table 5 details the modules to be taken at Stage 4 of all BSc and MPhys degrees

DIPLOMA AND OTHER SHORT TERM STUDENTS

Subject to timetable constraints, short-term students may generally choose, according to individual needs and adequate preparation, any combination of the modules offered in the Department. However, if you are seeking to qualify for the Physics or Forensic Science Diploma you must restrict your choice to level I modules or above. You are required to take 120 credits. The selection of modules for the Diploma should be made in accordance with the relevant programme specification (available on the Faculty website at http://www.kent.ac.uk/stms/staff-student/prog-specs.html) and be agreed in consultation with the Director of Undergraduate Studies. To qualify for the Diploma, you must follow your course of study for the full academic year.

Table 1 Forensic Science and Forensic Chemistry Degrees Stage 2		**Forensic Science (BSc) Forensic Science with a year in Industry (BSc)**	**Forensic Chemistry (BSc) Forensic Chemistry with a year in Industry (BSc)**
Module	Code	**FS FS(I)**	**FC FC(I)**
		Credit/Level	Credit/Level
Organic Chemistry	CH504		15/I
Chemical Identification Techniques	CH506	15/I	15/I
Numeracy Skills for Forensic Science	PS500	15/I	15/I
Forensic Physical Methods	PS501	15/I	15/I
Forensic Archaeology	PS502	15/I	15/I
Inorganic and Polymeric Materials	PS503		15/I
Forensic Ballistics and Collision Investigation	PS505	15/I	
Thermodynamics and Spectroscopy	PS520		15/I
Inorganic Chemistry	PS522	15/I	
Criminal Law for Forensic Sciences	LW562	15/I	15/I
Disasters	PH307	15/C *	
Physiology	BI513	15/I *	
Pharmacology	BI514	15/I *	

* Identifies optional module

Table 2
Physics Degrees
Stage 2

Module	Code	**Physics (BSc MPhys)** **Physics with a year in the USA (MPhys)** **P MP MP(U)**	**Physics with Astrophysics (BSc MPhys)** **Physics with Astrophysics with a year in the USA (MPhys)** **PA MPA MPA(U)**	**Physics with Space Science & Systems (BSc MPhys)** **Physics with Space Science & Systems with a year in the USA (MPhys)** **PSS MPSS MPSS(U)**	**Astronomy, Space Science & Astrophysics (BSc MPhys)** **Astronomy, Space Science & Astrophysics with a year in the USA (MPhys)** **ASSA MASSA MASSA(U)**	**Physics with Forensic Science (BSc)** **PFS**
		Credit/Level	Credit/Level	Credit/Level	Credit/Level	Credit/Level
Physics Lab II (30 credits)	PH500	30/I	30/I	30/I	30/I	
Quantum Physics	PH502	15/I	15/I	15/I	15/I	15/I
Atomic and Nuclear Physics	PH503	15/I	15/I	15/I		15/I
Optics & Electromagnetism	PH504	15/I	15/I	15/I	15/I	15/I
The Multiwavelength Universe & Exoplanets	PH507	15/I *	15/I		15/I	
Spacecraft Design and Operations	PH508	15/I *		15/I	15/I	
Multimedia for Astronomy, Astrophysics and Planetary Science	PH512				15/I	
Medical Physics	PH513	15/I	15/I	15/I		15/I
Physics Lab IIA	PH520					15/I
Mathematics II	MA588	15/I	15/I	15/I	15/I	15/I
Forensic Physical Methods	PS501	15/I*				15/I
Forensic Ballistics & Collision Investigation	PS505					15/I

* Identifies optional module

Table 3
Forensic Science and Forensic Chemistry Degrees
Stage 3

		Forensic Science (BSc) Year 3 **Forensic Science with a year in Industry (BSc) Final year**	**Forensic Chemistry (BSc)** **Year 3** **Forensic Chemistry with ayear in Industry (BSc) Final year**
Module	Code	**FS** **FS(I)**	**FC** **FC(I)**
		Credit/Level	Credit/Level
Analytical Chemistry	CH604	15/H	15/H
Medicinal Chemistry	CH606	15/H*	15/H
Research Project	CH620		30/H
Thermodynamics and Spectroscopy	PS520		15/I
Fires and Explosions	PS601	15/H	15/H
Forensic Presentation and Media Skills	PS602	15/H	15/H*
Forensic Science Project	PS620	30/H	
Topics in Functional Materials	PS701		15/M
Forensic DNA Analysis	BI637	15/H	
Law of Evidence for Forensic Science	LW573	15/H	15/H*
Image Processing	PH618	15/H *	

*Identifies optional module

Table 4 **Physics Degrees** **Stage 3: BSc, MPhys**		**Physics (BSc)**	**Physics with Astrophysics (BSc)**	**Physics with Space Science & Systems (BSc)**	**Astronomy, Space Science & Astrophysics (BSc)**	**Physics with Forensic Science (BSc)**	**Physics (MPhys)**	**Physics with Astrophysics (MPhys)**	**Physics with Space Science & Systems (MPhys)**	**Astronomy, Space Science & Astrophysics (MPhys)**
Module	Code	**P**	**PA**	**PSS**	**ASSA**	**PFS**	**MP**	**MPA**	**MPSS**	**MASSA**
		Credit/Level	Credit/Level	Credit/Level	Credit/Level	Credit/Level	Credit/Level	Credit/Level	Credit/Level	Credit/Level
Physics 3rd Year MPhys Project	PH600						15/H	15/H	15/H	15/H
Physics Problem Solving	PH602	15/H	15/H	15/H		15/H	15/H	15/H	15/H	
Physics Group Project	PH603	15/H	15/H	15/H	15/H	15/H				
Relativity, Optics & Maxwell's Eqns	PH604	15/H	15/H	15/H	15/H	15/H	15/H	15/H	15/H	15/H
Thermal & Statistical Phys	PH605	15/H	15/H	15/H	15/H	15/H	15/H	15/H	15/H	15/H
Solid State Physics	PH606	15/H	15/H	15/H			15/H	15/H	15/H	
Stars, Galaxies & the Universe	PH607		15/H		15/H					15/H
The Sun, the Earth & Mars	PH608			15/H	15/H				15/H	
Numerical & Computational Methods	PH611	15/H					15/H			
Physics Literature Review	PH616				15/H					15/H
Physics Project Laboratory	PH617	15/H	15/H	15/H	15/H	15/H				
Image Processing	PH618	15/H	15/H	15/H	15/H	15/H	15/H	15/H	15/H	15/H
Advanced Cosmology and the Interstellar Medium	PH712							15/M		15/M
Forensic Archaeology	PS502					15/I				
Fires & Explosions	PS601					15/H				
Physical Science Research Planning	PS700						15/M	15/M	15/M	15/M

Table 5

Physics Degrees

Year 4: MPhys, MPhys(U)

Module	Code	Physics (incl. with a year in USA) (MPhys) **MP MP(U)**	Physics with Astrophysics (incl. with a year in USA) (MPhys) **MPA MPA(U)**	Physics with Space Science & Systems (MPhys) **MPSS**	Astronomy, Space Science & Astrophysics (MPhys) **MASSA**	Physics with Space Science & Systems with a year in USA) (MPhys) **MPSS(U)**	Astronomy, Space Science & Astrophysics. with a year in USA) (MPhys) **MASSA(U)**
The Sun, the Earth and Mars	PH608			15/H	15/H		
Physics Research Project	PH700	60/M	60/M	60/M	60/M	60/M	60/M
Elementary Particles	PH702	15/M	15/M	15/M	15/M	15/M	15/M
Quantum Mechanics	PH704	15/M	15/M	15/M		15/M	
Space Astronomy and Solar System Science	PH709	15/M	15/M	15/M	15/M	15/M	15/M
Advanced Cosmology & the Interstellar Medium	PH712		15/M		15/M		15/M
Physical Science Research Planning	PS700					15/M	15/M
Topics in Functional Materials	PS701	15/M					

B2. MODULE DETAILS

The following catalogue of modules provides a reference for the content, aims, learning outcomes, method of assessment and recommended texts for all modules available to Stage 2,3 & 4 Chemistry, Forensic Science and Physics students.

The catalogue is presented by subject code and module number.

Subject code prefix	CH	is for	Chemistry modules
	PS		Physical Sciences (including Forensic Science)
	PH		Physics
	BI		Biology
	LW		Law
	MA		Mathematics

Module numbers in the	300	series are at	Level C
	500		Level I
	600		Level H
	700 & 800		Level M

We are constantly striving to provide the best teaching and learning environment for our students, and modules are reviewed annually to ensure that the content is appropriate for the overall aims of the degrees. There may be some minor changes to the content of some of the modules as a result of such reviews.

ORGANIC CHEMISTRY CH504

School of Physical Sciences Convenor Dr. S J Holder ECTS Credits 7.5
Taught in Autumn and Spring terms Kent Credits 15 Level I

Teaching Provision: 24 lectures, 6 laboratory days, 3 example classes

Prerequisites: CH308 and CH309.

Objectives:
This module will expand upon the basic organic and physical chemistry covered in CH309 and CH308 and provide an introduction to a more in-depth study of organic reactions and materials encountered in organic chemistry. In particular this module will place emphasis on classes of compounds and aspects (synthesis, properties) of organic chemistry not encountered (or not encountered in detail) by the student in CH309. Building upon the knowledge and skills obtained from CH309 fundamental reaction mechanisms will be expanded upon and in combination with a survey of the common organic compound classes, this will lead to the application of carbon-carbon bond forming reactions.

Subject-specific Learning Outcomes
Knowledge and understanding of

- Fundamental organic reaction mechanisms
- Chemistry and properties of alkyl halides
- Chemistry and properties of alcohols
- Chemistry and properties of ethers
- Chemistry and properties of amines
- Chemistry and properties of aromatic compounds
- Chemistry and properties of carbonyl compounds (including aldehydes, ketones and carboxylic acids)
- Fundamental C-C bond forming reactions.
- Strategies to synthesising complex molecules.

Generic Learning Outcomes:
By the end of this module students should:

- display an ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to the subject areas identified in the syllabus below.;
- display an ability to apply such knowledge and understanding to the solution of basic organic syntheses;
- be able to safely handle chemical materials, taking into account their physical and chemical properties, including any specific hazards associated with their use;
- be able to conduct standard laboratory procedures and operate standard chemical instrumentation involved in organic synthetic and analytical work;

SYLLABUS:

Reaction mechanisms (5 lectures)
Recap of polar reaction mechanisms: nucleophilic substitution, S_N1, S_N2; elimination, E1 and E2; electrophilic addition. Structure and reactions of alkenes.

Alkyl halides (2 lectures)
Properties of alkyl halides; synthesis of alkyl halides; reactions of alkyl halides.

Alcohols and ethers (3 lectures)
Properties of alcohols; synthesis of alcohols; reactions of alcohols; properties of ethers; reactions of ethers.

Amines (2 lectures)
Properties of amines; synthesis of amines; reactions of amines.

Aromatic Chemistry (3 lectures)
Benzene, structure and stability; other commonly encountered aromatic systems; reactions of aromatic rings, mechanism, reactivity and directing effects in basic electrophilic aromatic substitution reactions.

Carbonyl Chemistry (5 lectures)
Ketones and aldehydes: laboratory syntheses; nucleophilic addition reactions - reactions at the □ carbon; enolate chemistry - reactions at the □ carbon.
Carbon acidity, ionization, LDA, thermodynamic stability. Base character of alkali earths and lithium amides, O- vs. C-alkylation, aldol-type and Mannich reactions, reactions of enamines, □-alkylation, Michael-type addition, organocuprates.

Carbon-carbon Bond Forming Reactions (4 lectures)
Fundamental approaches and methodologies for carbon-carbon bond formation will be introduced.

Laboratory Classes
6 days; examples of the organic syntheses covered in CH504.

Assessment Methods: Written Examination 70%; Laboratory 20%; Example Classes 10%

Recommended texts:
1) G. Solomons, C. Fyhle, *Organic Chemistry*, 7th edition, New York, Chichester, Wiley, 2000 **+ earlier editions**
2) M. Jones, Jr., *Organic Chemistry*, 2000, W. W. Norton and Company, New York. **QD 253**
3) Lowry & Richardson, *Mechanism and Theory in Organic Chemistry*; 3rd ed., 1987, New York, London, Harper and Row. **QD 476 + earlier editions**
4) J. March and M. B. Smith, *"March's Advanced Organic Chemistry: Reactions, mechanisms and structure",* 5th ed, Wiley, 2001, **QD 258 + earlier editions.**
5) Oxford Chemistry Primers: *Willis & Wills*: Organic Synthesis;

Further texts may be recommended for individual topics.

CHEMICAL IDENTIFICATION TECHNIQUES **CH506**

School of Physical Sciences Convenor Dr S.J. Holder ECTS Credits 7.5
Taught in Autumn and Spring terms Kent Credits 15 Level I

Teaching Provision: 28 lectures, 2 workshop days, 4 examples classes
Prerequisites: CH308, CH309
Objectives:

This module will provide an understanding of the theory and application of the most widely applied techniques for chemical identification.

Learning outcomes
A. Knowledge and understanding of:

- The principles and procedures used in the characterisation and identification of chemical compounds.
- The principal techniques of structural investigations, including spectroscopy.

B. Cognitive Skills

- Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to the subject areas identified above.
- Ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems.
- Skills in the evaluation, interpretation and synthesis of chemical information and data.

C. Subject-specific skills:

- Ability to interpret data derived from laboratory observations and measurements in terms of their significance and the theory underlying them.

D. Transferable skills:

- Problem-solving skills, relating to qualitative and quantitative information, extending to situations where evaluations have to be made on the basis of limited information.

SYLLABUS:

Nuclear Magnetic Resonance [10 lectures] SJH
Simple theory of nuclear magnetic resonance, NMR. The NMR experiment and the spectrometer. The chemical shift and factors which affect it. Spin-spin coupling. Nomenclature of spin systems. Coupling constants. Simple 2nd order effects. Labile protons and NMR (alcohols, acids and amines). Magnetic and chemical inequivalence. Introduction to ^{13}C NMR spectroscopy.

Mass Spectrometry [5 lectures] JFJT
Basic theory and operation of the magnetic sector mass spectrometer. Interpretation of mass spectral data and fragmentation mechanisms. Gas chromatography/mass spectrometry.

Infrared and Raman Spectroscopy [4 lectures] GM
Experimental details. Applications of characteristic group frequencies. Determination of symmetry of simple molecules.

Basic Diffraction Methods [5 lectures] AVC
Production of X-rays and interaction with matter. Revision of basic structural concepts: unit cell, Miller indices, d-spacings, Braggs law. Powder X-ray diffraction: Experimental aspects, indexing of powder diffraction patterns of cubic lattices and determination of cell constant and lattice type. Systematic absences and crystal symmetry. Uses of powder diffraction. The relationship between crystal structure and intensity of diffraction maxima: atomic scattering factors; structure factors; Lorentz, polarisation, absorption and multiplicity factors. Fourier series and the phase problem. Single-crystal X-ray diffraction: Basic concepts and refinement of crystal structure data. Introduction to neutron diffraction. Electron diffraction in the transmission electron microscope. Comparison of X-ray, neutron, and electron diffraction.

UV-vis and Fluorescence Spectroscopy [4 lectures] SJH
Description of the theory of UV-vis electronic absorption. The colours of compounds and materials. HOMO-LUMO transitions and conjugation in p-systems. Typical organic chromophores and their absorption frequencies. Molar absorptivities and the Beer-Lambert Law. UV-vis spectra of inorganic compounds. Instrumentation and equipment for UV-vis spectrophotometry. UV-vis microspectrophotometric analysis. Forensic case studies. Uv-vis and RI detectors in HPLC. Basic theory of fluorescence spectroscopy. Excitation and relaxation. Stokes shift. Excitation and emission spectra. Fluorescent instrumentation and methods.

Laboratory workshops: Demonstration of NMR instrumentation and interpretation of NMR spectra [2 days]

Examples classes: Diffraction methods. Electron Spin Resonance. IR/Raman interpretation. Demonstration of mass spectrometer operation and interpretation of mass spectra.

Assessment Methods: Written examination 70%; Coursework 30%

Recommended texts:

Chang, *Physical chemistry for the chemical and biological sciences*. [QD 453.2]
Williams and Fleming, *Spectroscopic methods in organic chemistry*. [QDA76]
Abraham, Fisher *and Loftus, Proton and carbon-13 NMR spectroscopy*. [QD591]
W. Kemp, *Organic Spectroscopy* (3rd Ed), Macmillan 1991. [QD 272.S6]
Anthony R. West, *Solid State Chemistry and Its Applications* [QD454]

ANALYTICAL CHEMISTRY **CH604**

School of Physical Sciences Convenor: Dr. L. L. Boyle ECTS Credits 7.5
Taught in Autumn and Spring Terms Kent Credits 15 at Level H

Teaching Provision: 30 lectures, 4 examples classes, 1 revision class and more on request
Prerequisites: CH506

Objectives:
To increase the fundamental understanding of a range of physical techniques currently used in analytical chemistry, and to explore the potential applications of these techniques.

Subject-specific Learning Outcomes
1. Knowledge of the procedures required to ensure the collection of uncontaminated samples.
2. Training in the selection of appropriate instruments to analyse specific substances.
3. Indication of the sensitivity of the techniques involved and their suitability for detecting minute traces of substances.
4. Use of manufacturers' catalogues for equipment selection.
5. Training in problem-solving.

Generic Learning Outcomes
1. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and the relevant aspects of theories relating to the subject areas defined above.
2. The ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems.
3. Problem-solving skills where the balance of probability is involved.

SYLLABUS
Sample handling *(1 lecture)*
Avoidance of contamination: selection of protective clothing and tools; dependence of sampling method on the precision required. Purity problems with water, vessels and reagents. Assessment of costs.
Trace analysis: requirements of methods of detection; need for trial runs of equipment, methods and the operators. Common methods of detection.
Storage of samples: choice of containers; use of non-contaminating materials; preparation of containers; choice of tools for handling materials.
Types of purified water. Purity classification of reagents. Use of blanks in analysis.
Atomic emission/absorption spectrometry *(5 lectures)*
Revision of Beer–Lambert law and atomic energy-levels. Spark-source, flame- and plasma-emission spectrophotometry. Atomic absorption (AA) spectrophotometry. Flame structure and interferences. Electrothermal atomizers. Calibration techniques. Inductively-Coupled Plasma (ICP) / Atomic Emission Spectroscopy (AES).
High-performance liquid chromatography (HPLC) *(3 lectures)*
Differences between classical liquid chromatography and HPLC; characteristics of the instrument; advantages of the technique; comparison with gas chromatography; optimisation of separations. Instrumentation: the essentials of the system — solvent delivery, sample injection, the column, effluent detection and data processing. Use of a guard column. Normal-phase and reversed-phase techniques. Plate theory and comparison of chromatography with fractional distillation. Distribution constants, retention factors and selectivity factors.
Capillary zone electrophoresis (CZE) *(1 lecture)*
The basic idea, instrumentation, characteristics of the capillary, detection, reproducibility. The electro-osmotic flow and its pH dependence; control of the electro-osmotic flow; the zones, sample injection, injection methods. Examples of the analysis of anions and cations in water. Derivatisation and its use in amino-acid analysis.
Ion chromatography *(2 lectures)*
Factors affecting the separability of ions; methods of detection; selectivity and derivatisation; the three types of ion chromatography; structure of resins and mechanisms of exclusion of ions; elution and suppressor columns.
Mass spectrometry and associated chromatographic techniques *(11 lectures)***:**
Introduction: brief revision of CH506 topics; *w*hat is mass spectroscopy (MS)? Sample types and applications; reading references. Layout of MS; single-focus magnetic-sector MS. Ionization — electron ionization (EI); MS of propane and benzoic acid; parent molecular ions; isotope peaks. Resolution: precise masses; double-focusing MS. Mass-spectrometry time-scale; metastable ions. Mechanisms: examples of EI mass spectra (alcohols and amines): charge localisation, alpha cleavage, product stability, the McLafferty rearrangement. Ionisation energies (IE) and appearance energies (AE): potential-energy curves and determination of IE and AE.

Ionization methods: general introduction: sample types (organics: volatile thermally-stable substances, involatile thermally-unstable solids, biomolecules, eluents from HPLC, superfluid chromatography (SFC), CZE; polymers, inorganic salts and solutions thereof, metals, rocks and minerals). Chemical ionization (CI); electrospray ionization (ESI); matrix-assisted laser desorption ionization (MALDI); brief mention of ICP ionisation.
Types of commercially-available analysers: comparison of types**,** brief outline of *modus operandi* (with typical applications) of sector (already covered), time-of-flight, quadrupole, ion-trap, FTICR and hybrid instruments; portable mass spectrometers and miniaturized instruments.
Tandem mass spectrometry: principles; applications to compound identification and detection.
Quantitative mass spectrometry: applications in monitoring.
Use of computers in mass spectrometry: data acquisition, library searching, instrument control, fault diagnosis [note this last lecture may 'disappear' if the previous lectures over-run]
Electro-analytical chemistry *(2 lectures)*
Electro-analytical methods: conductivity, movement of particles, redox methods (potentiometry, acid-base titrations, precipitation reactions, redox titrations, electrolysis and polarography).
Optical microscopy *(2 lectures)*
Optical microscopy: cost-effectiveness; determination of cases where it is the appropriate method of analysis; use of non-polarised or polarised light and crossed polars; identification of rock fragments by shape and mineral composition; use of pleochroism and polarisation colours. The 2 lectures are based around actual demonstrations on the screen using a microscope projector.
Electron microscopy *(3 lectures)*
The principles of operation, specificity, sensitivity, precision, accuracy, utility, effectiveness and efficiency in terms of materials, time, cost when applied in a forensic context and use of both scanning electron microscopy (SEM) and transmission electron microscopy (TEM) and associated techniques such as atomic force microscopy.

Learning and Teaching Methods

Lectures 30 hours which provide the opportunity to learn and understand the theory and knowledge required.
Examples classes 4 hours which provide opportunities for discussion of the module topics and practice in problem-solving and answering examination-type questions.
Examples class work 16 hours which develops knowledge and understanding of the module and gives practice in problem-solving.
Revision class 2 hours on examination technique and clarifying difficulties
Private study 98 hours.

Assessment Methods: Examination: 90% Coursework: 10%

Recommended Texts:
N. B. These texts are recommended for reference rather than for purchase due to their high cost.
G. D. Christian, Analytical Chemistry, 6th Ed. New York; Chichester, Wiley, 2003. [QD 101.2]
D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Analytical Chemistry — An Introduction, 7th Ed. Fort Worth: Saunders College Publishing; 1999. [QD101.2]
D. A. Skoog, F. J. Holler and S. R. Crouch, Principles of Instrumental Analysis, 6th edition, Belmont (California), Thomson Higher Learning, 2007. [QD77.I5]
K. A. Rubinson and J. F. Rubinson, Contemporary Instrumental Analysis, 1st Ed. Upper Saddle River (New Jersey): Prentice-Hall, 2000.
E. de Hoffman, J. J. Charette and V. Stroobant, Mass Spectrometry — Principles and Applications, 2nd edition, Chichester, Wiley, 2001. [QD96.M3]

Lecturers:
Dr. L. L. Boyle: sample handling; HPLC; CZE; ion chromatography, electro-analytical methods; optical microscopy, electron microscopy.
Dr. M. J. Went: atomic emission/absorption spectroscopy.
Prof. J. F. J. Todd: mass spectrometry and associated chromatographic techniques.

MEDICINAL CHEMISTRY **CH606**

School of Physical Sciences Convenor Dr. A.Kanagassooriam ECTS Credits 7.5
Taught in Autumn and Spring terms Kent Credits 15 Level H

Teaching Provision: 22 lectures

Prerequisites: CH317

Aims:

This module is concerned with the principles and practice of drug design. Historical aspects of drug development and modern approaches to drug design, including their mechanism of action and the development and use of quantitative structure activity relationships, will be included.

Objectives:

On completion of the unit, students will be expected to have a working knowledge of a range of drugs and an understanding of the mechanism of action of selected agents. They should also be aware of the principles of drug design and be able to suggest modifications to molecular structures.

SYLLABUS:

Lecturer: Dr A Kanagasooriam

Peptidomimetics General approach to design of drugs based on peptides; peptide hormones, enzyme inhibitors; opiate analgesics.

Anti-infectives Including rational drug design; anti-HIV drugs, antibacterials and antifungals.

Drug action Receptor theory; review of physiochemical properties, ADME; drug discovery; tools & strategy; QSAR and set selection.

Neurotransmitters Catecholamines, acetylcholine, histamine; receptor structure; receptor sub-types; response to neurotransmitters; antagonists.

Continuous assessment: Written coursework.

Assessment Methods: Examination 80%; Coursework 20%

These will test the achievement of the learning objectives.

Timetable: Lectures; once per week.

Recommended texts:

Patrick, Introduction to Medicinal Chemistry, 2nd Edition. 2001.
Thomas Medicinal Chemistry an Introduction, Wiley, 2000.
Foye, Principles of Medicinal Chemistry, 4th edition, Lea and Febiger, 1981.
Ganellin and Roberts, Medicinal Chemistry; the Role of Organic Chemistry in Drug Research, 2nd Edition, Academic Press, 1993.
Nogrady, Medicinal Chemistry, 2nd Edition, Oxford University Press, 1988.
Smith and Williams, Drug Design, Wright PSG, 1983.

CHEMISTRY RESEARCH PROJECT

CH620

School of Physical Sciences Dr. S. Biagini ECTS Credits 15
Taught in Autumn and Spring terms Kent Credits 30 Level H

Teaching Provision: Project work (22 weeks)

Prerequisites: None

Aims

1. To provide an introduction to chemistry research methods
2. To prepare students for research careers either in industry or at postgraduate level
3. To deepen the students' knowledge in a specialised area of chemistry
4. To provide training and experience of communicating research results orally and in writing

Learning Outcomes

1. The pre-requisite knowledge to embark on a research degree
2. The capacity to undertake scientific investigations
3. A deeper knowledge of a specialised area of chemistry
4. Knowledge of the procedures involved in scientific research including the ability to write a scientific report and make an oral presentation

This project will run over the course of the first two terms. Students work individually on a topic chosen from a list under the guidance of a supervisor. The project is assessed on a number of criteria, which include the research work (amount, quality, etc), effort put in by the student, the preparation of a written project report and a presentation/question session. The student's understanding of the project and the related area will also be tested by means of a *viva voce* examination.

Assessment methods: Project Report 40%, Supervisor's mark 30%, *Viva voce* 10%, Oral Presentation 20%

Recommended reading: Guidance notes will be sent during the summer preceding the year in which the module will be undertaken. Literature as indicated by the project supervisor.

NUMERACY SKILLS FOR FORENSIC SCIENCE **PS500**

School of Physical Sciences Convenor to be announced ECTS Credits 7.5
Taught in Autumn and Spring terms Kent Credits 15 Level I

Teaching Provision: 24 lectures, 5 one-hour examples classes, 6 three-hour laboratory sessions.

Prerequisites: PS390.

Objectives: The aims of the module are to introduce the essential applied mathematical and computational skills required by forensic scientists. Many of these find expression in the handling of problems and experiments in chemical analysis. Other topics are more specialised, such as the relevance of conditional probabilities to evidence. The laboratory work gives experience of a range of analytical investigations with forensic applications, using several types of advanced instrumentation.

Learning outcomes:
An appreciation of where and how key elements of mathematics are used in analytical/chemical calculations
Appreciation of the handling of conditional probabilities, and the relevance to presentation of evidence; ability to compute these probabilities using Bayes' theorem
Understanding of the rationale of significance testing; ability to conduct basic significance tests
Skills in the operation of standard forensic instrumentation such as that used for analytical investigations and separation.
Ability to interpret data derived from laboratory observations and measurements in terms of their significance and the theory underlying them.

SYLLABUS:
Trace Analysis [4 lectures, 1 examples class]
Trace analysis: definitions, methods and problems. Sampling, storage and contamination. Quality control. Random and systematic errors; statistical treatment of data. Accuracy and precision. Signal/noise ratio. Sensitivity and detection limits. Choice of methods for trace analysis.

Chemical Arithmetic [4 lectures, 1 examples class]
Balancing chemical equations. Amount of substance, molar quantities, concentration and volumetric calculations, gravimetric analysis.
Equilibrium calculations, pH, acid-base equilibria, solubility.

Exponentials and logarithms in action [4 lectures, 1 examples class]
Units and dimensions.
Manipulation of exponentials and logarithms
Reaction rates, rate constants and orders of reaction
Rate laws and half lives, radioactivity, toxicity
The effect of temperature on reaction rate

Probability and Statistics [12 lectures, 2 examples classes]
Distribution of repeated measurements (Probability density functions): the normal distribution in detail, plus a look at log-normal, binomial, and Poisson distributions. Samples and populations, mean, standard deviation, standard error, confidence limits.
Review of "simple" probability of random variables
Quantitative treatment of the effect of evidence: Bayes' Theorem and conditional probability
A brief look at probability-based arguments used by expert witnesses, recent controversies and challenged convictions
Significance testing I: comparing two samples with a t-test. The null hypothesis, critical regions, one- and two-tailed tests. Error types.
Significance testing II: comparing sample variance, F-test
Regression and correlation

Laboratory work [6 three-hour sessions]
Quantifying the concentration of nitrite anions in a suspect sample
Analysis of alkaloids by HPLC
Accelerant analysis by gas chromatography
Determination of copper by atomic absorption spectroscopy
Isolation and purification of caffeine

Quantifying substances in a mixture using UV-visible spectroscopy

Assessment Methods: Written examination 70%; Practical 15%; Coursework 15%

Recommended texts:

If you have "S. K. Scott, Workbooks in Chemistry" from the 1st year you will find it useful here.

Your copy of

"Physical Chemistry for the Chemical and Biological Sciences", Chang
(USB 2000, ISBN:1-891389--06-8)

if you have one, will be useful.

Very good coverage of the maths in the context of analytical chemistry is in:-

"Statistics and chemometrics for analytical chemistry", Miller and Miller, Fourth edition (2000, Prentice Hall, ISBN: 0 130 22888 5)

If you prefer a book coming from a more mathematically-rigorous perspective, but illustrated with chemistry examples:-

"Basic mathematics for chemists", Tebbutt, Second edition
(1998 Wiley, ISBN: 0 471 97284 3)

The statistics part of the module is covered in

"Introduction to statistics for forensic scientists", Lucy
(2005 Wiley, ISBN 0 470 02201 9)

If you find the statistics particularly challenging, try:-

"Statistics without tears", Rowntree
(2000,Penguin, ISBN: 0 14 013632 0)

It's non-mathematical and excellent for getting a grasp of concepts.

FORENSIC PHYSICAL METHODS **PS501**

School of Physical Sciences Convenor Mr M Johnson ECTS Credits 7.5
Taught in Autumn term Kent Credits 15 Level I

Teaching Provision:
22 lectures: coursework, laboratory practical sessions, scene-of-crime assessment.

Aims:
To outline and define the scope and purpose of forensic physical methods in developed countries and to foster critical thinking in relation to these methods and their application.
To foster awareness of emerging methods in forensic physical methods.

Learning Outcomes:
1. An understanding of the role of physical forensic methods in forensic practice.
2. Knowledge and critical awareness of the major physical forensic methods.
3. An understanding of emerging developments in forensic science
4. The ability to identify and present critical findings of a forensic physical nature

SYLLABUS:

Crime Scene management and evidential procedures : 5 Lectures (MRJ)
Scene assessment, definition, and safety: access control and contamination protocols.
Major incident management: Disasters and terrorist incidents.
Support and scene preservation requirements.
Evidence recovery management: preservation and packaging of samples.
Evidential procedures and requirements.
In depth investigation.
Scene search techniques and methods
Evidential report and statement preparation.
Witness reliability
The cognitive statement
Witness handling and statement taking

Fingerprint Recovery 2 lectures (MRJ)
History and nature of fingerprints.
Location and enhancement. UV and white light search, oblique light photography.
Development and recovery. Chemical and physical enhancement methods.
Preservation and evidential considerations.

Contact and Trace Evidence Marks and Impressions: 6 Lectures (MRJ)
First principles: Locard's Theory.
Types of C&T evidence.
Location and recovery.
Fluid splash and impact angle analysis
Interpretation of evidence.
Relative value of recovered samples.
Scope of forensic document examination.
Identification of handwriting, types of variation, signatures and type of forgery, photocopies.
Printing and printers, typewriters, inks, paper and physical composition, folds, tears.
Impressions: recovery of impressions from scene, 2-D impressions, enhancement techniques, blood. Test impressions and comparison, finding relevant information and conclusions. Case histories.
Instrument marks: Cutting instruments, levering instruments, examples. Case Histories.
Impressed fits, mass-produced items, number/trademark erasure.
Puncture and slash wounds.

FACIAL COMPOSITES AND EYEWITNESS ID (5)
The need and role of eyewitness ID, legal issues, psychological issues, the science of facial ID, facial models,
principles of composites generation, comparative studies.

AUTOMATED FACIAL RECOGNITION (1)

FINGERPRINTS (4)
Why are they unique? History. Characteristics, enhancement, standard testing procedures, automation and modem methods, AFIS, future developments

Laboratory Work
1: Fingerprint Recovery:

Forensic physical techniques – practical sessions.

2. Contact and trace evidence

Scene-of-crime practical assessment
1 Class test: Covering all material presented in lectures.

Assessment Methods: Examination 50%, Coursework 10%, Laboratory Work 10%, Scene-of-crime assessment 30%

Recommended Text: Criminalistics (An introduction to Forensic Science), Richard Saferstein, Prentice Hall. ISBN 0-13-013827-4

Supplementary reading: Crime Scene to Court, Edited by Peter White, ISBN 0-85404-539-2

FORENSIC ARCHAEOLOGY **PS502**

School of Physical Sciences Convenor Dr M J Went ECTS Credits 7.5
Taught in term 2 Kent Credits 15 at Level I

Teaching Provision: 19 lectures, 1 lab session and 4 problem sessions

Prerequisites: None

Co-requisites: None

Subject Specific Learning Outcomes:

1. Knowledge of the principle areas of forensic archaeology including dating, detection and human osteology.
2. Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to forensic archaeology.
3. Ability to apply such knowledge and understanding to the solution of problems.

Synopsis of the Curriculum:
Dating (6 lectures + 2 problem sessions): Radioactive decay and detection of radiation, radiocarbon dating and related methods, accelerator mass spectrometry, uranium series dating, potassium-argon dating, radioactive tracers, isotope dilution, neutron activation, stable isotope techniques with forensic applications, electron spin resonance spectroscopy, thermoluminescence dating and thermal history, Lindow Man, detection of irradiated food.
Detection (5 lectures + 2 problem sessions): Magnetometry, metal detectors, resistivity surveys, ground penetrating radar, aerial photography, and cosmic ray radiography.
Human Osteology (6 lectures + 1 lab sessions)
Case Studies (2 lectures): Archaeology case studies exemplifying the use of forensic archaeology techniques for interpretation.

Learning and teaching methods
Lectures 19h that provide the opportunity to learn and understand the theory and knowledge required for outcome 1.
Problem Sessions 4h that provide opportunities for discussion of the module topics and practice in problem solving and answering examination questions (outcomes 1-3)
Lab session 2h that provides experience in artefact identification (outcomes 1-3)
Private study 68h reading lecture notes and books (outcomes 1-3), 20h problem solving (outcomes 1-3), 37h revision and examination (outcomes 1-3)

Assessment Methods and how these relate to testing achievement of the intended learning outcomes:
Written examination 70% (outcomes 1-3); Coursework 30% (outcomes 1-3)

Suggested Reading:
Zumdahl, Chemical Principles
Aitken, Science-based Dating in Archaeology
Zimmerman and Angel, Dating and Age Determination of Biological Materials
Geyh and Schleicher, Absolute Age Determination
Dickin, Radiogenic Isotope Geology
Libes, Introduction to Marine Biogeochemistry
Clark, Seeing Beneath the Soil.

INORGANIC AND POLYMERIC MATERIALS **PS503**

School of Physical Sciences Convenor Prof. A.V. Chadwick ECTS Credits 7.5
Taught in Terms Autumn and Spring terms Credits 15 Level I

Teaching Provision: 22 lectures, 7 laboratory days, 3 example classes

Prerequisites: CH308.

Objectives:

1. To provide an introduction to the principles underlying the structures and properties of inorganic solids and polymers, and to present a range of important examples of materials which illustrate these principles.

LEARNING OUTCOMES:

1. An understanding of the basics of crystallographic nomenclature.
2. An understanding of the links between crystal structure and chemical bonding for solids.
3. The ability to classify solids on the basis of chemical bonding.
4. A basic understanding of the nature of defects in solids and their role in chemical and physical properties.
5. A basic understanding of non-stoichiometry in solids.
6. A knowledge of the chemistry of zeolites and their applications.
7. A knowledge of the types of polymer and their properties.
8. A knowledge of the synthetic methods used to prepare carbon based polymers.
9. The ability to recognise basic polymer structures.
10. Skills required for the conduct of standard laboratory procedures involved in synthetic inorganic and polymer chemistry.
11. Skills in the monitoring, by observation and measurement, of chemical properties, events or changes, and the systematic and reliable recording and documentation thereof.
12. Skills in the operation of standard chemical instrumentation.
13. Ability to interpret data derived from laboratory observations and measurements in terms of their significance and the theory underlying them.
14. Ability to conduct risk assessments concerning the use of chemical substances and laboratory procedures.

GENERIC LEARNING OUTCOMES:

1. Skills in presenting scientific material in a poster.
2. Interpersonal skills, relating to the ability to interact with other people and to engage in team work.

SYLLABUS:

Solid State Inorganic Chemistry: Structures and Materials [13 lectures]

Basic Crystal Structures: Close-packed structures. The structures adopted by simple binary solids. The rock salt, CsCl, sphalerite, wurtzite and nickel arsenide structures. The fluorite and rutile structures.
Bonding in Solids: Ionic bonding and the ionic model. Molecular solids, Band theory.
Defects in Solids.
Transport and Reactivity in Solids: Diffusion and electrical transport in solids. Solid state reactions.
Oxide Structures: Structures of ionic solids, principally oxides: corundum, ReO_3, perovskites, spinels. Octahedral and tetrahedral holes in close-packed lattices.
Non-Stoichiometry: Types of non-stoichiometry in solids. Detailed examples including $Fe_{1-x}O$ and ReO_{3-x}.
Zeolites: Structural features of Si-O chains and networks in silicates; aluminium and metal ions in aluminosilicates. Zeolite compositions and structures: sodalite, Zeolites A,X,Y and ZSM5; channels and cavities. Synthesis of zeolites. Applications of zeolites for ion exchange , molecular absorption and catalysis.

Polymer Chemistry [9 lectures]

Introduction: What is a polymer? Molecular mass distributions, M_n, M_w and PDI. The structure property relationships of typical natural polymers, modified natural polymers and synthetic polymers discussed qualitatively. Chain reaction polymerisation: Structure, kinetics and mechanism in chain polymerisation (free radical, anionic, cationic).

Practical work:

This will focus on the structural analysis of inorganic and polymeric materials.

Learning and teaching methods

Lectures 22h which provide the opportunity to learn and understand the theory and knowledge required for outcomes 1-9.

Examples classes 3h which provide opportunities for discussion of the module topics and practice in problem solving and answering examination questions (outcomes 1-9)

Laboratory classes 30h which provide hands-on experience of inorganic chemistry and polymer, good laboratory practice, use of instruments and experiment report writing (outcomes 10-14)

Poster Session 2h which provide practice in scientific poster presentation and teamwork (outcomes 15-16)

Private study 42h reading lecture notes and books (outcomes 1-8), **15h** laboratory write-ups (outcomes 1-13), **12h** examples class work (outcomes 1-8), **4h** poster preparation (outcomes 15-16), **20h** revision (outcomes 1-8, 13)

Assessment Methods: Written examination 70% (outcomes 1-9); Practical 20% (outcomes 1-14); Example classes 10% (outcomes 1-9, 15-16)

Recommended texts:

Smart and Moore, Solid State Chemistry, Chapman and Hall, 1992.
Physical Chemistry, P.W. Atkins (OUP)
Physical Chemistry for Students in Chemical & Biological Sciences, Raymond Chang (USB)
Polymers, D. Walton and P. Lorimer (Oxford Science Publications)
Polymers: Chemistry and Physics of Modern Materials, J.M.G.Cowie (Blackie).

FORENSIC BALLISTICS AND COLLISION ANALYSIS **PS505**

School of Physical Sciences Convenor Mr M Johnson ECTS Credits 7.5
Taught in Spring term Credits 15 Level I

Teaching Provision: 22 lectures, 8 two hour workshops, 6 three hour laboratory practical sessions, field trip.

Aims:
Introduce ballistics in relation to firearms and trajectories.
Build and understanding of the mechanisms and processes associated with collisions.

Learning Outcomes.
1. Understanding firearm ballistics, firearm identification and classification, and ballistic trajectory calculations relevant to forensic investigations.
2. Recovery and interpretation of ballistic evidence.
3. Key knowledge and computational skills essential to collision/accident analysis and investigation.
4. Build a working knowledge of major incident and disaster management with specific reference to forensic evidence recovery.
5. The ability to collate and present findings within judicial constraints.

Syllabus.

Forensic Numerical Skills: 2 Lectures, 2 two hour example workshops.
Significant figures: Rounding and truncation, use of calculators.
SI units: Standardisation of measurement powers and prefixes.
Errors: Random and systematic, identification and elimination.
Error propagation: Error estimation and accuracy.
Measurement limitations: Degrees of accuracy, instrument limitations.
Manipulation of equations: Algebraic manipulation.
Introducing trigonometry:
Properties of triangles, calculation of parameters.
Pythagoras Theorem:
Basic trig functions: Sine, cosine, tangent.
Trigonometric relationships.
Relate trig functions to forensic and ballistic applications.
Vector Resolution: 2 and 3 dimensional.

Forensic Ballistics: 8 Lectures, 4 two hour example workshops.
Internal, external (flight), and terminal ballistic theory.
Impact effects and evidence.
Wounds and injury evidence.
Ballistic flight: Trajectories and parabolic arcs.
Anomalous ballistic flight
Bullets and debris.
Laws of Motion: Investigative applications.
Conservation of linear momentum: Concepts and calculations.
Vector resolution.

Collision Analysis. 6 lectures, 2 two hour example workshops.
Friction coefficients: Measurement and calculation.
Skid Marks: Visual Analysis:
Linear and Curved: Multi Surface.
Critical Curve: Velocity Calculation.
Vector and Multiple Impacts.
Scene Analysis.
Momentum Transfer.

Firearms and Ammunition. 5 lectures.

Firearm identification and classification
Firearm operation and mechanisms.
Ballistic Evidence: Data and recovery.
Ammunition Evaluation and Identification.
The Bullet: Evidential recovery and markings.
The Cartridge: Evidential recover and markings.
Propellant composition and chemistry.

Firearms: Legislation and Social Perspective: 1 Lecture

Legal classification of firearms.
History and development of firearms legislation.
Social implications.
Firearms in crime.

IED: 1 lecture.

Bombs and Explosions:
Hazards and evidence.
Types of IED
Crater effect and calculation.
Blast front velocities
Debris scatter and recovery.
Incident control and management.

Laboratory Work: 6 three hour sessions.

Ballistic Evidence Recovery.
Ammunition Evaluation
Friction Coefficients.
Acceleration Due to Gravity.
Momentum Exchange.
Ballistic Flight.

Field Trip:

Kent Police Tactical Firearms and Training Unit Maidstone.

Assessment Method:

Examination 60%, Laboratory Assignments 40%.

Recommended Text:
Criminalistics (An introduction to Forensic Science), Richard Saferstein, Prentice Hall. ISBN 0-13-013827-4
Understanding Firearm Ballistics, R.A. Rinker. Mullberry Hs, USA ISBN 0-9645598-4-6
Supplementary reading:
Practical Skills in Forensic Science, Pearson Press ISBN 0-131-14400-6

THERMODYNAMICS AND SPECTROSCOPY **PS520**

School of Physical Sciences Convenor Prof. A.V. Chadwick ECTS Credits 7.5
Taught in Autumn and Spring terms Kent Credits 15 Level I

Teaching Provision: 24 lectures, 5 laboratory days, 3 example classes

Prerequisites: CH308, CH309.

Objectives:
1. To show how chemical equilibrium and change can be quantified in order to shed light on the stability of molecules and how they react.
2. To explore the foundations of thermodynamics
3. To develop basic spectroscopy.
4. To develop basic reaction kinetics.

LEARNING OUTCOMES:
1. A knowledge of chemical thermodynamics, kinetics and spectroscopy.
2. The ability to use thermodynamics to predict the feasibility of chemical reactions.
3. The recognition of the differences and links between the macroscopic thermodynamic and microscopic statistical viewpoints.
4. The skill to perform calculations using thermodynamic data.
5. The skill to perform practical experiments to gain thermodynamic information.
6. A knowledge of basic spectroscopy; microwave, infra-red, visible/UV.
7. The skills to derive molecular parameters from spectroscopic information.
8. A basic knowledge of reaction kinetics.
9. The skill to operate standard chemical instrumentation.
10. The skills to record experimental observations and to evaluate the experimental errors.
11. The ability to interpret data derived from laboratory measurements in terms of their significance and the underlying theory.

GENERIC LEARNING OUTCOMES
12. Skills in presenting scientific material in a poster.
13. Interpersonal skills, relating to the ability to interact with other people and to engage in team working.

SYLLABUS:
Thermodynamics [10 lectures]
Revision of Stage 1 material: significance of various energy terms; chemical potential and its central role; the standard state; mean and partial molar quantities.
Perfect gas mixtures and ideal solutions; deviations from ideality; activity in terms of chemical potentials.
The thermodynamic equilibrium constant and the prediction of feasibility of heterogeneous reaction. Ellingham diagrams.
Determination of activity coefficients (non-electrolytes and electrolytes).
Electrolytes: mean ionic quantities; ionic strength; Debye-Hückel theory from chemical potential;
Electrochemical cells. Determination of K_w etc.
Thermodynamic mixing functions; excess functions; molecular view of ideality.
Colligative properties; elevation of b.p., depression of m.p., osmotic pressure.
A further look at equilibrium: effect of T, p; relative importance of ΔS^0 and ΔH^0.
Basic Spectroscopy [8 lectures]
Revision of Part I material: operation of spectrometer, equipartion of energy, quantization of energy. Electronic transition in molecules: visible/UV, calculation of energy levels, selection rules.
Rotation of molecules; energy levels, transitions, microwave spectroscopy.
Vibration in molecules; linear, non-linear molecules, energy levels, infra-red spectroscopy, selection rules
Calculation of molecular parameters from spectroscopic data; moments of inertia, bond energies, bond lengths, etc.
Reaction Kinetics [6 lectures]
Experimental methods, rates of reaction, rate constant and order of reaction, rate laws, activation energies; thermodynamic and kinetic control.
Mechanisms of reactions**:** Relation between kinetics and mechanism, elementary reactions and molecularity, consecutive reactions, formation of intermediate complex, steady state approximation, ‘third body’ effect, parallel reactions, opposing reactions, chain reactions.

Practical work:
This focuses on thermodynamic measurements; determination of ΔG, ΔH, ΔS, etc. from various types of experiment. Spectroscopic measurements and the derivation of quantitative information. Determination of rate constants.

Learning and teaching methods
Lectures 24h which provide the opportunity to learn and understand the theory and knowledge required for outcomes 1-4, 6-8.
Examples classes 3h which provide opportunities for discussion of the module topics and practice in problem solving and answering examination questions (outcomes 1-4, 6-8)
Laboratory classes 30h which provide hands-on experience of physical chemistry, good laboratory practise, use of instruments and experiment report writing (outcomes 1-11)
Poster Session 2h which provide practise in scientific poster presentation and teamwork (outcomes 12, 13)
Private study 42h reading lecture notes and books (outcomes 1-4, 6-8), **15h** laboratory write-ups (outcomes 1-11), **12h** examples class work (outcomes 1-4, 6-7), **4h** poster preparation (outcomes 11, 12), 20h revision (outcomes 1-4, 6-7)
Assessment Methods: Written examination 70% (outcomes 1-4, 6-8); Practical 20% (outcomes 5, 9-11); Examples classes and poster session 10% (outcomes 1-4, 6-8, 9-11, 12, 13)
Recommended texts:
Atkins, Physical Chemistry (OUP).
Chang, Physical Chemistry for Students in Chemical and Biological Sciences (University Science Books).
Banwell, Fundamentals of Molecular Spectroscopy (McGraw-Hill)

INORGANIC CHEMISTRY

PS522

School of Physical Sciences Convenor Dr M J Went ECTS Credits 7.5
Taught in terms 1 and 2 UKC Credits 15 at level I

Pre-requisites: None
Co-requisites: CH308
This module is a pre-requisite for: PS503

Subject Specific Learning Outcomes: By the end of the module a student should:

1. understand the principles of inorganic chemistry, including the major types of chemical reactions.
2. be familiar with characteristic properties of the elements and their compounds, including group relationships and trends within the s, p, d and f-blocks of the periodic table.
3. understand the preparation, purification and analysis of a range of inorganic compounds using techniques such as ion-exchange chromatography, infra-red and uv-vis spectroscopy.
4. have the ability to interpret data derived from laboratory observations and measurements in terms of their significance and the theory underlying them.
5. have skills in the safe handling of chemical materials and in the conducting of standard laboratory procedures involved in synthetic work in relation to inorganic systems.

SYNOPSIS OF THE CURRICULUM
General Background [4 lectures]
Atomic structure. Electronegativity. Periodicity. Hard and soft acids and bases. Types of chemical bond. Lewis structures. Physical properties of ionic and covalent compounds. The structures of covalent main group compounds predicted by valence shell electron pair repulsion theory (VSEPR).
d-Block (Transition Metal) Chemistry [10 lectures]
Stereochemistry of metal complexes: geometrical, optical, structural, ionisation/hydration, linkage, coordination isomerism.
Bonding in transition metal complexes. Crystal field theory: crystal field splitting, factors effecting crystal field splitting, the spectrochemical series, low spin and high spin complexes, crystal field stabilisation energy (CFSE), hydration energy of M^{2+} ions, site selection in spinels and the Jahn Teller effect. Preparation and reactivity of transition metal complexes.
Colours of complexes: d↔d spectra, spin and Laporte selection rules, intensities of absorptions. Measurement of ligand field splitting energy. Charge transfer absorptions.
Diamagnetism, paramagnetism, magnetic moment. Experimental measurement of the number of unpaired electrons in a complex.
Some aspects of the chemistry of 3d transition metals; comparison with 4d and 5d series.
Thermodynamic and kinetic stability of metal complexes. Stability constants. The chelate effect. Lability of ligands.
f-Block Chemistry [3 lectures]
Comparison with the d-block elements. Position of lanthanides and actinides in the periodic table. Electronic configuration, oxidation states and chemistry. The lanthanide contraction. Separation of lanthanide elements. f↔f spectra. Chemistry of actinides: uranium.
s- and p-Block (Main Group) Chemistry [7 lectures]
A brief overview of the properties and chemistry of the elements in Groups 1, 2, 13-18. Topics included are occurrence, extraction, purification and uses; ionisation energy, oxidation states, the diagonal relationship, donor-acceptor complexes, pi-bonding, toxicity and forensic applications.

Laboratory: [5 half days]
Experiments in preparative and analytical inorganic chemistry, to include: the separation of nickel and cobalt by ion-exchange chromatography; measurement of the ligand field splitting energy in a titanium (III) complex; preparation and properties of complex ions; isomerism in coordination complexes.

Learning and Teaching Methods
Lectures 24h which provide the opportunity to learn and understand the theory and knowledge required for outcomes 1-4. Problems set during lectures will give practice in problem solving and answering examination questions and provide opportunities for discussion of the module topics. (outcomes 1-4)
Laboratory classes 15h which provide hands-on experience of preparative inorganic chemistry and experiment report writing (outcomes 1-5)
Private study 50h reading lecture notes and books (outcomes 1-4), 30h laboratory write-ups (outcomes 1-5), 11h problem solving (outcomes 1-4) 20h revision (outcomes 1-4)

Assessment Methods and how these relate to testing achievement of the intended learning outcomes:
Laboratory: 24% (outcomes 1-5), Problems: 16% (outcomes 1-4), Examination: 60% (outcomes 1-4)

Suggested Reading:

Cotton, Wilkinson and Gaus, Basic Inorganic Chemistry.
Greenwood and Earnshaw, Chemistry of the Elements.
Winter, d-Block Chemistry
Jones, d- and f-Block Chemistry
Henderson, Main Group Chemistry

FIRES AND EXPLOSIONS **PS601**

School of Physical Sciences Convenor Dr. R.E. Benfield ECTS Credits 7.5
Taught in Autumn and Spring terms Kent Credits 15 Level H

Teaching Provision:	30 lectures, including contributions by practitioners from the Forensic Science Service and the Forensic Explosives Laboratory.
Pre-requisites:	Successful completion of Stage 2 of the Forensic Science degree programme; or equivalent background

Objectives:
To present the methods applied in the forensic investigation of fires and explosions.

Subject-specific Learning Outcomes:
- Knowledge and understanding of:
- – The physics and chemistry of fires and explosions.
- – The principal areas of forensic investigation of fires and explosions.
- – The analysis and identification of accelerants, incendiary devices, explosives and explosive residues.
- – The management of fire and explosion scenes.
- – The observation and assessment of damage to buildings and vehicles, and injury to persons.
- – Identification of the causes of fires and explosions, and their classification as natural, accidental, negligent or deliberate.

Generic Learning Outcomes:
- Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to the subject areas identified above.
- Ability to apply such knowledge and understanding to the solution of qualitative and quantitative problems.

SYLLABUS:

Physics and chemistry of fires and explosions (14 lectures and seminars):
Fire and arson – occurrence and importance. Combustion – definitions. Thermodynamics and enthalpy. Flammability limits, flash point, fire point, ignition temperature. Pyrolysis of wood and plastics. Fuels and accelerants. Propagation and spread of fires. Sampling and laboratory analysis of fire scene residues.
Explosions – definitions. Vapour phase and condensed phase explosions. Detonation and deflagration. High and low explosives. Primary and secondary high explosives. Molecular design of explosives. Survey of important explosives. Stoichiometry, oxygen balance, gas pressures, thermodynamics and enthalpy. Sampling and laboratory analysis of explosives residues. Preventative detection of explosives in contexts such as airports.

Fires (8 lectures):
Propagation and spread of fires – flames, fire types, flashover. Fire investigation. Forensic Science Service procedures at the scene. Damage observation and assessment. Fire and smoke patterns. Sources of ignition. Injuries and fatalities. Evidence recovery: sampling and laboratory analysis. Finding the cause: natural, accidental, negligent or deliberate? Indicators of arson. Evidence procedures. Case studies.

Explosions (8 lectures):
The work of the Forensic Explosives Laboratory. Trace analysis of explosives: recovery, extraction and analysis of samples. Bulk analysis. Identification of explosives: organics and inorganics. Physical evidence: detonators. Explosion scene control and examination procedures. Damage observation and assessment. Preventative detection. Precursor identification. Explosives evidence in court: legal definitions and procedures. Terrorism. Case studies.

Learning and teaching methods:
Lectures 30 h provide the opportunity to learn and understand the theory and knowledge required to achieve the learning outcomes.
Coursework 18 h develops knowledge and understanding of the module material and gives practice in problem-solving and answering examination questions
Private study and revision 102 h

Assessment:	Coursework (3 problem sheets and written assignments)	20%
	Examination (Unseen, formal written end-of-year; 3 hours)	80%

Together these assessments will test achievement of all the intended learning outcomes.

Recommended reading:

Crime Scene to Court, the Essentials of Forensic Science, 2nd edition, ed. P. White. Royal Society of Chemistry, 2004. ISBN: 0854046569. Chapters 8 and 9. [KB290]
Criminalistics, 8th edition, R. Saferstein. Prentice Hall, 2004. ISBN: 0131228897. Chapter 11 [HV8073 Saf]
Forensic Science, A.R.W. Jackson & J. M. Jackson. Pearson, 2004. ISBN: 0130432512. Chapters 10 & 11 [HV8073]
Kirk's Fire Investigation, 5th edition, J. DeHaan. Prentice Hall, 2002. ISBN: 0130604585 [TH9180]
The Chemistry of Explosives, 2nd edition, J. Akhavan, Royal Society of Chemistry, 2004. ISBN: 0854046402 [TP270]

FORENSIC PRESENTATION & MEDIA SKILLS — PS602

School of Physical Sciences Convenor M.J.Went — ECTS Credits 7.5
Taught in Autumn and Spring terms — Kent Credits 15 at Level H

Teaching Provision: 12 lectures, poster session, expert witness role play.

Prerequisites: None

Subject Specific Learning Outcomes:

1) Ability to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to Forensic Science
2) Skills in presenting scientific material and arguments clearly and correctly, in writing and orally, to a range of audiences.

Generic Learning Outcomes:

3) Communication skills, covering both written and oral communication.
4) Time-management and organisational skills, as evidenced by the ability to plan and implement efficient and effective modes of working.

Synopsis of the Curriculum:

a) Investigating how science is reported in the media. Writing a press release.
b) Writing a forensic science article. Scientists and in particular forensic scientists need to communicate to non-scientific audiences. Instruction and experience will be gained in writing a "popular" science article as would be found in New Scientist.
c) Designing, producing and presenting a poster. Posters are a valuable way of communicating at conferences.
d) Acting as an expert forensic science witness. Writing, presenting and defending an expert witness report.

Learning and teaching methods

Introductory lecture (1h plus 1h private study) (outcomes 2, 3), Investigating how science is reported in the media (2h class plus 2h private study) and Writing a press release (2h class plus 12h private study) (outcomes 1-4), Instruction in writing an article (1h lecture plus 1h private study) (outcomes 2,3). Selection of topic and production of article outline (1h class plus 10h private study) (outcomes 1-4) Writing the article (1h class plus 30 hours private study) (outcomes 1-4), Introduction to posters (1h lecture plus 1h private study) (outcomes 2,3), Poster production (1h class, 26h private study)(outcomes 1-4), Poster presentations and assessment (6h) (outcomes 1-4), Lectures on the role of the expert witness (4h plus 8h private study) (outcomes 1,2,3), Writing expert witness reports (30h) (outcomes 1-4). Expert witness role play (6h) (outcomes 1,2,3)

Assessment Methods and how these relate to testing achievement of the intended learning outcomes: This module is assessed by coursework. Press release 15% (outcomes 1-4), Forensic science article 25% (outcomes 1-4), Poster 10% (outcomes 1-4), Writing and defending expert witness reports 50% (outcomes 1-4)

Suggested Reading:

Communicating Science - A handbook, Shortland and Gregory, Longman, 1991
National and local newspapers
Forensic Science journals
New Scientist
Getting the Message Across - Key Skills for Scientists, RSC/GlaxoWellcome, 3rd Edition, September 2001
Presentation Skills, Siddons, Institute of Personnel and Development, 1998
Preparing scientific illustrations: a guide to better posters, presentations and publications, Briscoe, Springer 1996.
Scientific Publications and Presentations, Davis, Academic Press, 1997
Forensic science and the expert witness, Phillips and Bowen, Law Book Co., 1985
Crime Scene to Court - The essentials of forensic Science, Ed P. White, RSC, 1998
The Expert Witness in Court: A practical guide, Bond, Solon and Harper 1999.
Forensic Science, Jackson and Jackson, 2004
Practical Skills in Forensic Science- Langford etc, 2005.

FORENSIC SCIENCE PROJECT **PS620**

School of Physical Sciences Dr. S. Biagini ECTS Credits 15
Taught in Autumn and Spring terms Kent Credits 30 Level H

Teaching Provision: Project work (22 weeks)

Prerequisites: None

Aims

1. To provide an introduction to research methods
2. To prepare students for research careers either in industry or at postgraduate level
3. To deepen the students' knowledge in a specialised area of forensic science
4. To provide training and experience of communicating research results orally and in writing

Learning Outcomes

1. The pre-requisite knowledge to embark on a research degree
2. The capacity to undertake scientific investigations
3. A deeper knowledge of a specialised area of forensic science
4. Knowledge of the procedures involved in scientific research including the ability to write a scientific report and make an oral presentation

This project will run over the course of the first two terms, two days per week. Students work individually on a topic chosen from a list under the guidance of a supervisor. The project is assessed on a number of criteria, which include the project work (amount, quality, etc), effort put in by the student, the preparation of a written project report and a presentation/question session. The student's understanding of the project and the related area will also be tested by means of a progress report.

Assessment methods: Project report 50%, Supervisor's mark 20%, Progress report 10%, Oral Presentation 20%

Recommended reading: Guidance notes will be sent during the summer preceding the year in which the module will be undertaken. Literature as indicated by the project supervisor.

PHYSICAL SCIENCE RESEARCH PLANNING — PS700

School of Physical Sciences Convenor Prof M Smith — ECTS Credits 7.5
Taught in Autumn and Spring terms — Kent Credits 15 Level M

Teaching Provision: 8 lectures, 2 example classes, 4 tutorial/workshop sessions with the convenor and 16 tutorial/workshop sessions with specialist supervisors, and an extended written exercise.

Prerequisites: A working knowledge of core modules is assumed as a platform for the final stage of the unit.

Co-requisite: PH600

Aims:

Students will develop a number of skills related to the planning and preparation of a research proposal. Students will learn how to search and retrieve information from a variety of locations (books, databases, websites etc). They will learn how to compile a professionally-produced document such as a grant proposal for funding a research activity in a direction of their own. They will exercise presentation skills of their grant proposal in front of members of staff.

Learning Outcomes:

1. Knowledge of specific research areas at the current frontiers.
2. Knowledge of the way in which research is funded.
3. The basic of the operation of funding bodies.
4. Basic of patents and IPR.
5. In preparing the research proposal, students will develop abilities to identify relevant principles and laws related to the subject of their proposal;
6. Ability to present and interpret information graphically;
7. Ability to communicate scientific information, in particular to produce clear and accurate scientific reports, perform oral computer aided presentation;
8. Ability to use appropriate C&IT packages/systems for the analysis of data and the retrieval of appropriate information.
9. Students will also acquire investigative skills in the context of independent investigation including the use of textbooks and other available literature, databases, make use of appropriate research-based materials or other learning resources as part of managing their own learning and the interaction with members of staff to extract important information.

GENERIC LEARNING OUTCOMES

10. Increased presentation skills, particularly use of Powerpoint.
11. IT skills to search for data.
12. Ability to write reports.
13. Ability to estimate costs of research.
14. Interpersonal skills, relating to the ability to interact with other people and to engage in presentation sessions.

SYLLABUS:

- Research skills
- Colloquium attendance
- Revision of methods of searching the scientific literature (e.g, Web of Science)
- Introduction to sources of information concerning research funding
- How the Research Councils (EPSRC), PPARC) work
- How other funding bodies (e.g. PPARC) operate
- Peer review of research proposals
- Identifying research areas and collaborators
- Writing a case for support
- Costing research
- Completing a research proposal form
- Power point presentation of the research proposal

Details of the work to be done will be announced by the convenor during the first two weeks of the academic year.

Learning and teaching methods

Lectures: ***15h*** which provide the opportunity to learn basic research skills, costing of research, etc. (outcomes 1-4).

Attendence at research colloquia: ***4h*** students attend 4 of the departmental colloquia (outcomes 1-4)

Presentation Session: ***2h*** which provide practise in scientific presentation and teamwork (outcomes 7, 8, 10, 11, 13)

Private study: ***30h*** reading lecture notes and books (outcomes 1-4), ***16h*** preparation of colloquium reports (outcomes 1, 7, 12)), ***80h*** preparation of proposal outline and full proposal (outcomes 1-9, 11-13).

Assessment Methods: Coursework 100%
Each of the components will be assessed on an individual basis.

1. The preparation of two reports on research colloquia; 20% (2×7.10%) [testing learning outcomes 1, 7, 9, 12]
2. The preparation of a summary of the research proposal based on research activity in SPS; 10% [testing learning outcomes 5-13].
3. Presentation of proposal to staff; 20% [testing learning outcomes 5-8, 10, 14].
4. Case for support; 50% [test learning outcomes 2-9, 13].

Recommended reading:

1. http://www.epsrc.ac.uk/
2. http://www.pparc.ac.uk

Further texts will be recommended for individual topics

Minor changes may occur to the syllabus during the year

TOPICS IN FUNCTIONAL MATERIALS **PS701**

School of Physical Sciences Convenor Prof. A.V. Chadwick ECTS Credits 7.5
Taught in Autumn and Spring terms Kent Credits 15 at Level M

Teaching Provision: 30 lectures 3 examples classes.

Prerequisites: CH503 or PH606

Objectives:
Chemists and physicists are now playing an important role in the growing field of materials research. The solid state has always been of interest to physicists, but mainly as a test-bed for theoretical models of matter. Solid state is a relatively new area of study for chemists with the focus being on structure and spectroscopy. However, more recently there has been a growing interest, driven by technological needs, in materials with specific functions and this requires a combination of physics and chemistry. For example, new materials are needed for the energy industry (batteries and fuel cells), for the optics and electronics industry (semiconductors, lasers and wave-guides), and for the environment (sensors, actuators and 'smart' materials). This is an area of rapid growth and requires an understanding of the fundamental chemistry (e.g. the atomic structure of the material) and physics (the role of structure on physical properties). Functional materials are now dealt with as a specific programme by national research councils and there are many new journals in this interdisciplinary field. The aim of this module is to introduce students to this area of modern materials.
In addition to providing the student with a general appreciation of materials there are a number of specific objectives. The first of these is knowledge of materials preparation and crystal growth, the starting point of any materials study. The second is the detailed structures of materials and the role of defects. Motion of matter and charge is important to many areas of materials, both fundamental and technological. A section will follow this on glasses, systems of immense contemporary interest. Therefore a prime objective of the module is to treat these areas in some detail. A final objective is to provide the student with information on modern experimental techniques. Since the surfaces of solids are important in many processes, the techniques used to probe surface structure and composition is an essential part of this module.

LEARNING OUTCOMES:
1. An understanding of current topics of interest in materials research.
2. A knowledge of the methods of purification of materials and crystal growth.
3. A knowledge of the methods of chemically and physically characterizing solids.
4. A knowledge of advanced defect physics of solids.
5. An awareness of the applications of materials in industry.
6. Ability to demonstrate knowledge and understanding of the essential facts, concepts and principles relating to materials.
7. Ability to apply the knowledge to solve problems in materials.
8. An understanding of the basic phenomena of the electronic structure of materials.

SYLLABUS:

Crystal growth [3 lectures] (Prof. Chadwick)
Methods of producing ultra-high purity materials. Crystal growth techniques; solution, vapour and melt methods. Assessment of crystal quality.
Structure of molecular crystals [2 lectures] (Prof Chadwick)
Structures of crystals composed of non-polar molecules, dipolar molecules and crystals with charge-transfer interactions.
Molecular motion in solids [4 lectures] (Prof Chadwick)
Prescription of types of motion a molecule can undergo. Experimental and theoretical techniques for the study molecular motion.
Defect chemistry and matter transport of molecular and ionic crystals [4 lectures] (Prof Chadwick)
Basic types of defect; vacancy, interstitials and impurities. Special case of ionic crystals; Schottky and Frenkel defects. Diffusion mechanism in solids. Experimental techniques for the study of diffusion; radiotracer, NMR, scattering methods.
Liquid crystals [5 lectures] (Dr. Holder)
History of liquid crystals. Introduction to the types of liquid crystal; thermotropic and lyotropic. Classification of systems; nematic, smectic, cholesteric, etc. Properties and applications.
Glasses and techniques for studying non-crystalline solids [6 lectures] (Dr. Mountjoy)

Glasses and the non-crystalline solids. Preparation and applications of glasses. Techniques for characterising the structure of glasses and non-crystalline solids.
Experimental techniques for characterizing solid surfaces and surfaces [6 lectures] (Prof Todd and Prof Chadwick)
Secondary ion mass spectroscopy.
Synchrotron techniques.

Learning and teaching methods

Lectures; *30h* which provide the opportunity to learn and understand the theory and knowledge required for outcomes 1-8.
Examples classes; *3h* which provide opportunities for discussion of the module topics and practice in problem solving and answering examination questions (outcomes 1-8)
Private study; 60h reading lecture notes and books (outcomes 1-8), ***15h*** examples class work (outcomes 1-8), ***42h*** revision (outcomes 1-8)
Assessment Methods: Examination 80% [testing outcomes 1-8]; Coursework (problem sheets and essays) 20% [testing outcomes 1-8]

Recommended texts:
Wright, Molecular Crystals, Cambridge University Press, 1995, [QD921].
West, Solid State Chemistry, Wiley, 1992, [QD454]
Smart and Moore, Introduction to Solid State Chemistry, Chapman & Hall, 1992, [QD454].
Agullo-Lopez, Catlow and Townsend, Point Defects in Materials, Academic, 1988, [QC 176.8.D3].
A. P. Sutton, "The electronic structure of materials", Oxford University Press ISBN: 0198517548
Interrante and Hamden-Smith, "Chemistry of Advanced Materials" Wiley, 1998 [TA403]
Hirsch "Topics in Electron Diffraction and the Microscopy of Materials", IOP, 1999 [QC213]
Philibert "Atom Movements", Editions de Physique, 1991 [QC176]
Collings and Patel "Handbook of Liquid Crystal Research", OUP, 1997 [QD923]
Supplemented by up-to-date research literature from "Web of Science" and lecturers' own research publications in peer-reviewed journals.

PHYSIOLOGY **BI513**

Biosciences   Convenor Dr. M.J. Allen   ECTS Credits 7.5
Taught in Autumn and Spring terms   Kent Credits 15 Level I

Prerequisites: BI305 Fundamental Human Biology for those students without Biology A level or equivalent, BI307 Human Physiology and Disease strongly recommended.

Subject Specific Learning Outcomes: On the successful completion of this module students will be able to demonstrate:

1. An understanding of integrated human physiology and the physiology of nerve, muscle, blood, kidney, stomach and intestine, and of their interplay and relation to disease.
2. Have acquired practical and theoretical knowledge of physiological techniques, especially how these relate to disorder.

Learning and Teaching Methods: Lectures: 24h; Practicals: 6h; Supervisions: 2h; Self Study: 118h.

Lectures:

Physiological systems:
Overview of Physiology, Cells and Tissues; Signalling pathways; Introduction to the Endocrine system

Nervous System:
Overview of anatomy of the nervous system: general organization, functional systems (motor, sensory, cognitive, autonomic etc); Synaptic structure and function: transmitters and receptors; Sensory systems: vision and/or hearing and inherited/acquired sensory defects

Muscle:
Muscle types and muscle regulation; Cellular mechanisms of muscle function: contractile machinery (actin, myosin, etc), sliding filament theory; Motor systems: reflexes, voluntary movements, diseases of muscles and motorneurons

Blood and the Cardiovascular system:
Cardiovascular system: the heart and blood vessels; Hematopoiesis; Composition and functions of blood; Diseases of blood: cancers (leukaemia etc) anemias, thalassemia.

Kidney:
Structure and functions of kidney; Filtration; Reabsorption

Gastro-intestinal physiology:
The GI tract; Digestion and regulation of GI function

Practicals:

1. Skeletal muscle biomechanics
2. Biochemical properties of blood cells

Supervisions:

1. Problem based question in physiology.
2. Assessing a scientific paper relating to physiology

Methods of Assessment: Practical report: 30%; Supervisions: 10%; Examination: 60%.

Core Text:
Silverthorn, D – *Human Physiology – An Integrated Approach* (3rd Edition) Pearson Education, 2004. This text makes excellent linkage between physiological principles and medical case presentations, with web support.

Recommended Reading:
Smith, C – *Elements of Molecular Neurobiology* (3rd Edition) John Wiley and Sons, 2001.

PHARMACOLOGY **BI514**

Biosciences Convenor Dr. D. Lloyd ECTS Credits 7.5
Taught in Autumn and Spring terms Kent Credits 15 Level I

Pre-requisites: Core Stage 1 modules; BI307 Human Physiology and Disease is recommended

Learning Outcomes: On the successful completion of this module students will be able to:

1. Demonstrate an understanding of receptors, ion channels, enzymes and carrier molecules as drug targets.
2. Describe drug-receptor interactions at the molecular level.
3. Understand systems pharmacology – e.g. cardiovascular and central nervous systems – and the action of therapeutic agents in diseased states.
4. Demonstrate both a practical and theoretical knowledge of pharmacological techniques.

Learning and Teaching Methods: Lectures: 22h; Practicals: 6h; Workshop: 3h; Self Study: 119h.

Lectures:
Pharmacodynamics and chemical transmission:

Introduction and basic principles of drug action
Structure and function of receptors and ion channels
Neurotransmission. Neurons and synapses, neuromuscular junctions, autonomic nervous system, adrenergic and cholinergic nerve terminals, neuromodulation
Local transmission. Inflammatory response: role of histamine

Systematic pharmacology:

The Cardiovascular System. Regulation of blood pressure, angina and cardiac failure
The Respiratory System. Pathogenesis of asthma, mode of action of bronchodilators and anti-inflammatory agents
The Central Nervous System

- Central neurotransmitters and opioids
- Local and general anaesthetics
- Treatment of anxiety and sleep disorders
- Treatment of schizophrenia, Parkinson's disease and mania/depression
- Drugs of abuse and withdrawal symptoms

The Endocrine and Reproductive Systems. Corticosteroids, contraception and pregnancy, treatment of subfertility
Chemotherapy. General principles of antibiotic/antiviral/antifungal/anticancer agents

Pharmacokinetics:

Drug absorption, distribution, excretion, metabolism and toxicity

Practical:

Drug receptor binding analysis

Workshop:

Students will be presented with a series of clinical conditions, which will be discussed in the workshop. Students will then evaluate treatment possibilities for each of the conditions described, their mode of action, potential complications, and finally the most suitable therapeutic strategy for the individual patient. This assessment will be completed in class.

Assessment Methods: Workshop: 20%; Practical: 20%; Examination: 60%.

Required and Recommended Reading:
Required:
Neal, M.J. Medical Pharmacology at a Glance, 4th edition (2002), Blackwell Science.

Recommended:
Rang, H.P., Dale, M.M., and Ritter, J.M. Pharmacology, 5th edition (2003), Churchill Livingstone.
Katzung, B.G. Basic and Clinical Pharmacology, 8th edition (2000), McGraw-Hill.

FORENSIC DNA ANALYSIS **BI637**

Biosciences | Convenor Dr. P.J. Nicholls | ECTS Credits 7.5
Taught Autumn term | Kent Credits 15 Level H

Pre-requisites: BI300 Introduction to Biochemistry

Subject Specific Learning Outcomes: On successful completion of this module, students will be able to:

1. Identify the facets of DNA typing procedures that can cause failure of analyses and be able to select the most appropriate parameters for a given type of DNA analysis.
2. Use information gained from DNA analysis to determine the likelihood that a given individual was involved in a crime.
3. Be aware of the most up to date technologies for DNA analysis and be competent in maintaining that awareness.

Learning and Teaching Methods: Lectures: 24h; Practical: 12h; Fingerprinting Workshop: 4h; Self Study: 110h.

Lectures:

Forensic sample preparation and additional biological indicators:

This section will include the following topics:
Sample preparation for DNA analysis; examination of body fluids; basic principles of DNA fingerprinting.
Analysis of DNA from single cells; forensic applications of DNA analysis in non-violent crimes.
Comparison of the advantages and disadvantages of DNA-based and non-DNA based analytical techniques; forensic entomology; forensic botany.

Forensic DNA typing:

This section will include the following topics:
Forensic DNA analysis – overview; Polymerase chain reaction (PCR) : principles, applications and pitfalls; DNA sequencing; genetic fingerprinting case studies; interpretation of DNA profiles; mitochondrial DNA analysis; “ancient” DNA.

Workshop: DNA fingerprinting analysis.

Practical: Polymerase chain reaction.

Methods of Assessment: Practical: 15%; Short Answer Test: 10%; DNA Fingerprinting Problem Solving: 15%; End of Year Examination: 60%.

Recommended Reading:

Brown, T.A. , Genomes 2, Bios Scientific Publishers
Jackson, A.R.W., and Jackson, J.M., Forensic Science, Pearson Education Ltd.
Langford, A et al., Practical Skills in Forensic Science, Pearson Education Ltd.
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CRIMINAL LAW FOR FORENSIC SCIENTISTS **LW562**

KLS Convenor Dr Deborah Cheney ECTS credits: 7.5.
Taught in Autumn term Kent Credits 15 Level I

This Module is taught in the Autumn Term.

This module introduces students in forensic science to aspects of the procedure and practice of the criminal process. It provides grounding in the concepts and principles underlying criminal law and looks at specific offences, in particular relating to homicide and non-fatal offences, which are especially relevant to forensic science students.

Preliminary Reading:
Ashworth, A, Principles of Criminal Law, Oxford University Press, 4th edition, 2003
Heaton, R, Criminal Law, Oxford University Press, 2nd edition 2006 (this is the required textbook for this module)

Method of Assessment : 100% coursework. An essay plan and written assessment comprises 80% of the module grade, made up of a written essay plan (10%) and written assessment (70%). The remaining 20% of the coursework attaches to a multiple choice test.

Contact hours: 20 hours of lectures; 10 hours of seminars (approximately).

THE LAW OF EVIDENCE FOR FORENSIC SCIENTISTS LW573

KLS Convenor Lisa Dickson ECTS credits: 7.5.
Taught in Autumn Term only Kent Credits 15 Level H

Note: This module is only available for students on one of the Forensic Science programmes.
LW562 is normally a prerequisite but in special cases may be taken as a co-requisite

Module Details:
The role of evidence in a courtroom is technical but its rules reflect core principles of the due process of law. These are becoming more significant with the implementation of the Human Rights Act 1998 and it is important for forensic scientists, who may act as expert witnesses, to have an understanding of these rules and their operation in the trial process. This module considers the position of forensic evidence within the trial process, rules governing the recognition of such evidence and the perception of its value in the trial. In addition matters such as the function of the judge and jury, burden and standard of proof, and hearsay are considered from a central focus of how they relate to forensic evidence.

Summary Intended Learning Outcomes:
Students will
- have a good understanding of the relationship between the rules of evidence and the role of forensic science in the courtroom.
- be aware of the main sources relating to evidence, from a range of disciplines. They should be able to use these materials for research purposes
- have a good understanding of the rules of evidence considered

Method of Assessment: 100% coursework

Contact Hours: 20 hours lectures; 10 hours seminars (approximately)

Preliminary Reading:

Dennis I: The Law of Evidence (Sweet and Maxwell 2nd ed. 2002)

DISASTERS **PH307**

School of Physical Sciences Convenor Prof A V Chadwick ECTS Credits 7.5
Taught in Autumn Term Kent Credits 15 Level C

Teaching Provision: 10 lectures and 10 seminars

Prerequistes: None

Co-requisites: None

Objectives: To study of particular cases in which disasters occur (for example, shipping disasters, the Chernobyl explosion, earthquakes), either as a result of human participation or in the "natural" course of events.

LEARNING OUTCOMES:

1. Development of a perspective on scientific reasoning.
2. Knowledge of the scientific basis of disasters.
3. Knowledge of the human impact of disasters.
4. Knowledge of the economic impact of disasters.
5. Ability to judge scientific and technical reports in the media.

GENERIC LEARNING OUTCOMES:

6. Ability to research information sources for primary data.
7. Skills in presenting scientific material in an essay format.
8. Interpersonal skills, relating to the ability to interact with other people and to engage in seminar work.

SYLLABUS:

Hurricanes, volcano eruptions, earthquakes, shipping disasters, stock market crashes, viruses crashing important servers world-wide and the Chernobyl explosion are all topics which can partly be understood from a scientific viewpoint. In a fairly clear sense, they represent situations in which the usual smooth-running laws of science breakdown (perhaps in the way that wars represent a breakdown in the usual diplomatic relations between states), but in recent years methods have been developed which give some insight into catastrophic events. This module will cover a number of phenomena, many of them well known and well publicised giving a clear account of each and discussing the scientific, technical and human contributions to the disaster. The module is given by physicists and chemists but the general tone and language is not at all technical. The questions we shall ask are: How are these disasters caused? Are they avoidable? What is their impact on human society? The module will be structured on a number of case studies, illustrating very different features by searching for common elements. This course includes a lecture on the general theme of the limitations of “scientific” evidence.

Learning and teaching methods:
Lectures: ***10h*** 10 1-hour lectures in a single term. Each lecture provides the basic information on a particular disaster.(outcomes 1-5)
Seminars: *10h.* 10 1-hour seminars in a single term. Each seminar follows a specific lecture and involves discussion of a disaster, consideration of impacts, human issues, etc. (outcomes 1-6, 8)
Private study: *30h*. Reading lecture notes. ***50h.*** Preparation of material for seminars, researching primary sources, ***50h.*** Preparing materials and writing essays (outcomes 1-7).

Methods of Assessment: 100% coursework - two 2,500 word essays - (50% of final mark each) [outcomes 1-7].

Preliminary Reading:

J W N Sullivan, *Limitations of Science* (QC21)
Leo Tolstoy, *War and Peace,* (epilogue) (PS 3366.V6);
Nevil Shute, *Sliderule,* Heinemann, 1957

PHYSICS LABORATORY II

PH500

School of Physical Sciences Dr. G. Mountjoy — ECTS Credits 15
Taught in Autumn and Spring terms — Kent Credits 30 Level I

Pre-requisites: PH300 and PH301.

Aims:
To learn essential practical aspects of Physics as defined in the learning outcomes (see below), and to observe physical phenomena and experimental demonstrations of physical laws.

Learning Outcomes:
1. To carry out experiments, analyse the results (including uncertainty), and draw conclusions.
2. A familiarity with experimental equipment and procedures.
3. The systematic and reliable recording of experimental data.
4. An ability to use mathematical techniques to model physical phenomena.
5. To present and interpret information graphically.
6. To use computers for retrieval of information and analysis of data.
7. To communicate scientific information, in particular to produce scientific reports.
8. Transferable skills - problem-solving, investigative (independent use of reference materials), communicative, analytical, and personal.

SYLLABUS:

Most practicing physicists at some point will be required to perform experiments and take measurements. This module, through a series of experiments, seeks to allow students to become familiar with some more complex apparatus and give them the opportunity to learn the art of accurate recording and analysis of data. This data has to be put in the context of the theoretical background and an estimate of the accuracy made. Keeping of an accurate, intelligible laboratory notebook is most important. Each term three two week experiments are performed. The fourth two week period is allocated to some additional activities to develope experimental and communications skills

Teaching Provision: There will be 9 x 7hr laboratory sessions in Term 1, and 8 x 7hr laboratory sessions in Term 2. This module is expected to occupy 300 total study hours, including the contact hours above.

Assessment Methods: Coursework 100%. Six laboratory reports (Type 1), one communications exercise, one set of electric ciruits exercises, and two extended reports (Type 2).

Core Text: Kirkup L., *Experimental Methods* [Q182.3, 3 copies]
(John Wiley and Sons, 1994, ISBN 0471335797, paperback, approx. £13.)

Recommended Texts: Taylor J.R., *An Introduction to Error Analysis* [QA275, 8 copies]

QUANTUM PHYSICS **PH502**

School of Physical Sciences   Convenor Prof P Strange   ECTS Credits 7.5
Taught in Autumn term   Kent Credits 15 Level I

Prerequisites: PH300 and PH301.

Aims: To provide an introduction to quantum mechanics, developing knowledge of wave-functions, the Schrodinger equation, solutions and quantum numbers for basic physical problems.

Subject specific Learning Outcomes:

Knowledge and understanding of

1. physical laws as applied to quantum mechanics.
2. mathematics necessary to describe quantum mechanical phenomena
3. the key concepts of elementary quantum theory.
4. applications of quantum theory
5. the difference between classical and quantum theory.
6. the need for quantum theory and some key experiments in its history.
7. the quantum theory of the harmonic oscillator, rotation and angular momentum, the hydrogen atom, tunneling, and other simple quantum mechanical models.

Generic Learning Outcomes:

1. An ability to use mathematical techniques to model physical behaviour.
2. An ability to present and interpret information graphically.
3. An ability to use appropriate texts, or other learning resources to managing their own learning.
4. An improved problem solving ability using physical laws and mathematics
5. Transferable skills - problem solving and analytical.
6. an ability to manipulate precise and complex ideas and construct logical arguments.

SYLLABUS:

A. Background to Quantum Mechanics (approx. 6 lectures)
Revision of classical descriptions of matter as particles, and electromagnetic radiation as waves. Some key experiments in the history of quantum mechanics. The concept of wave-particle duality.

B. Foundations of Quantum Mechanics (approx. 6 lectures)
Physical states represented by the wavefunction. Probability density. Physical observables represented by operators. Physical systems described by the Schrodinger equation and its solutions. Stationary states. Eigenfunctions and eigenvalues. Expectation values.

C. Simple physical systems with constant potentials (approx. 6 lectures)
Free particles. Particles in a box. Classically allowed and forbidden regions. Reflection and transmission of particles incident onto a potential barrier. Probability flux. Tunnelling of particles.

D. Physical systems representing important physical phenomena (approx. 12 lectures)
The simple harmonic oscillator as a model for atomic vibrations and infrared radiation. Revision of classical descriptions of rotation. Rotation in three dimensions as a model for molecular rotation and microwave radiation. The Coulomb potential as a model for H atom and UV-visible radiation. The quantum numbers l, m and n.

Teaching Provision: There will be 30 lectures and 4 workshops and 2 tests in Term 1. This module is expected to occupy 150 total study hours, including the contact hours above.

Assessment Methods: Weekly problems 10%, class tests 20%, final examination 70%.

Core Text: Brehm J.J. and Mullin W.J., *Introduction to the Structure of Matter* [QC21.2, 14 copies]

Recommended Texts: Young H.D. and Freedman R.A., *University Physics with Modern Physics* [QC21, 11 copies],
Rae A.I.M, *Quantum Mechanics* [QC174.1, 2 copies],
Cassels J.M., *Basic Quantum Mechanics* [QC174.1, 2 copies],
and *PH502 notes* on SPS web page (should be viewed with IE)

ATOMIC AND NUCLEAR PHYSICS **PH503**

School of Physical Sciences Dr. G. Mountjoy ECTS Credits 7.5
Taught in Spring Term Kent Credits 15 Level I

Teaching Provision: 31 lectures, 2 class tests, 3 example classes

Prerequisites: PH300, PH301, PH502

Aims: The module will provide a basic introduction to atomic and nuclear physics based on a quantum formulation.

Learning Outcomes:
1. Knowledge and understanding of physical laws and principles of atomic and nuclear physics and their application to diverse areas of physics. More specifically, an understanding of the way in which the quantum numbers *n*, *l*, *m* and *s* influence the properties of electrons in atoms and of nucleons (p and n) in nuclei. An appreciation of how the theoretical formalism is related to experimental observations.
2. Ability to: identify relevant principles and laws when dealing with problems of atomic and nuclear physics and to make approximations necessary to obtain solutions; solve problems of atomic and nuclear physics using appropriate mathematical tools; make use of appropriate texts or other learning resources as part of managing their own learning.
3. Problem-solving skills, in the context of both problems with well-defined solutions and open-ended problems of atomic and nuclear physics.
4. Analytical skills – associated with the need to pay attention to detail, to construct logical arguments and to use technical language correctly.

SYLLABUS:
***Atomic Physics [14 lectures, 1 example class, 1 class test]**
Review of previous stages in the development of quantum theory with application to atomic physics; Atomic processes and the excitation of atoms; Electric dipole selection rules; atom in magnetic field; normal Zeeman effect; Stern Gerlach experiment; Spin hypothesis; Addition of orbital and spin angular moments; Lande factor; Anomalous Zeeman effect; Complex atoms; Periodic table; General Pauli principle and electron antisymmetry; Alkali atoms; ls and jj coupling; X-rays.
Nuclear Physics [17 lectures, 2 example class, 1 class test]
Properties of nuclei: Scattering experiments, differential cross-section, Rutherford scattering. Size, mass and binding energy, stability, spin and parity, magnetic dipole moment.
Experimental Nuclear Physics: Scintillation and solid state detectors. Particle accelerators; van de Graaf, cyclotron, linear accelerator, synchrotron.
Nuclear Models: Semi-empirical mass formula M(A, Z), stability, binding energy B(A, Z)/A. Shell model, magic numbers, spin-orbit interaction, shell closure effects.
Nuclear Forces: Range of nuclear forces, saturation, properties of the deuteron, spin-dependent forces. Nuclear Reactions: Scattering and absorption, direct reactions, Q-value. Fission and fusion reactions, chain reactions and nuclear reactors, nuclear weapons, uranium isotopes and plutonium, thermo-nuclear reactions, solar energy and the helium cycle.
Beta decay: Energetics and stability, the positron, neutrino and anti-neutrino properties,. Parity non-conservation in weak interactions, symmetry in physics.
Teaching/learning and strategies used to enable outcomes to be achieved and Demonstrated
Lectures and worked examples supported by example classes; personal study using textbooks, handouts, web-based material and other self-study material.
Total study hours expected of students: 150 hours

Assessment Methods: Examination 70%, Coursework 10%. Two class tests 20%. One class test will assess the learning objectives related to Atomic Physics and the other class test the learning objectives related to Nuclear Physics.

Recommended Texts:
Kenneth S. Krane, Introductory nuclear physics, New York, 1988, {QC 173
Brehm and Mullin, Introduction to the Structure of Matter. Wiley, 1989 [QC21.1]
See course webpage:
*URL: **http://www.kent.ac.uk/physical-sciences-local/teaching-materials/physics.htm**

Minor changes may occur to the syllabus during the year

OPTICS AND ELECTROMAGNETISM II **PH504**

School of Physical Sciences Convenor Prof. A. Podoleanu ECTS Credits 7.5
Taught in Term 1 Kent Credits 15 at Level I

Teaching provision 32 lectures, 2 examples classes, 2 class tests = 36 contact hours
Prerequisites PH300 and PH301

Aims
1.To provide a conceptual framework for electromagnetism at the level needed for an understanding of the propagation of electromagnetic waves in free space.
2.To relate optics to electromagnetism, and to provide a good basic grounding in modern optics.

Learning outcomes
1. Knowledge and understanding of physical laws and principles of electromagnetism and optics and their application to diverse areas of physics. More specifically, an understanding of the way in which materials modify electric and magnetic fields, and how the effects may be characterised in terms of the four vectors E, D, B and H; an appreciation of the use of complex numbers in problems involving harmonic oscillation; increased fluency in the use of vector field methods; ability to discuss and analyse key optical phenomena such as polarisation, diffraction and interference as well as components such as lasers.
2. Ability to: identify relevant principles and laws when dealing with problems of electromagnetism and optics and to make approximations necessary to obtain solutions; solve problems of electromagnetism and optics using appropriate
mathematical tools; use mathematical techniques and analysis to model physical behaviour; make use of appropriate texts or other learning resources as part of managing their own learning.
3. Problem-solving skills, in the context of both problems with well-defined solutions and open-ended problems of electromagnetism and optics .
4. Analytical skills – associated with the need to pay attention to detail, to construct logical arguments and to use technical language correctly.

SYLLABUS:
Electromagnetism [18 lectures, 1 example class, 1 class test]
*Electrostatic image*s: Point charge and plane; point and sphere, line charges.
*Magnetic fiel*d: Field of current element or moving charge; Div B; magnetic dipole moment, forces and torques; magnetic scalar potential; Ampere's circuital law.
*Magnetizatio*n: Susceptibility and permeability; boundary conditions on field vectors; fields of simple circuits.
*Electromagnetic inductanc*e: Inductance; magnetic energy and energy density; magnetic circuits.
*Field equation*s: Maxwell's equations; the E.M. wave equation in free space.
Application of complex numbers in electric circuits.
Vectors: Review of Grad, Div & Curl; other operations with ∇.
Electrostatics: Coulomb's Law, electric field and potential, Gauss's Law in integral and differential form; the electric dipole, forces and torques.
Isotropic dielectrics: Polarization; Gauss's Law in dielectrics; electric displacement and susceptibility; capacitors; energy of systems of charges; energy density of an electrostatic field; stresses; boundary conditions on field vectors.
Solutions of electrostatic problems: The Poisson and Laplace equations; conducting sphere in a uniform field; numerical methods.
Electrostatic images: Point charge and plane; point and sphere, line charges.
Magnetic field: Field of current element or moving charge; Div **B**; magnetic dipole moment, forces and torques; magnetic scalar potential; Ampere's circuital law.
Magnetization: Susceptibility and permeability; boundary conditions on field vectors; fields of simple circuits.
Electromagnetic inductance: Inductance; magnetic energy and energy density; magnetic circuits.
Field equations: Maxwell's equations; the E.M. wave equation in free space.
***Optics [14 lectures, 1 example classs, 1 class test]**
Polarisation: mathematical descriptions of linear, circular and elliptical states; unpolarised and partially polarised light; production of polarised light; the Jones vector. Birefringence (mechanical oscillator model, evolution of polarisation, waveplates, polarisers, double refraction, circular birefringence), Jones calculus.
Interference: Classes of interferometer – wavefront splitting, amplitude splitting and their fibre equivalents. Basic concepts including coherence, polarisation, multiple beams and reflection at a dielectric interface.
Diffraction: Introduction to scalar diffraction theory: diffraction at a single slit, rectangular slit and circular apertures, diffraction grating.

Teaching/learning and strategies used to enable outcomes to be achieved and Demonstrated
Lectures and worked examples supported by example classes; personal study using textbooks, web-based material and other self-study material.

Total study hours expected of students: 150 hours

Assessment methods
Written (unseen) examination, 2 hours, 70%. Class tests: 20%. Coursework involving problems assessed throughout the year will contribute 10% of the overall mark. One class test will assess the progress towards the learning objectives in terms of electromagnetism and another class test in terms of optics.

Core texts
D.J. Griffiths, Introduction to Electrodynamics, 3rd Ed. (1999), Prentice Hall
Tipler, P. A., Physics 4th Edition, W.E. Freeman (QC21)
E Hecht, Optics, 2nd, Ed. (1987) Addison-Wesley.
***URL: http://www.kent.ac.uk/physical-sciences-local/teaching-materials/physics.htm**

Minor changes may occur to the syllabus during the year

THE MULTIWAVELENGTH UNIVERSE AND EXOPLANETS **PH507**

School of Physical Sciences Convenor Prof M Smith ECTS Credits 7.5
Taught in Spring term Kent Credits 15 at Level I

Teaching Provision: 30 lectures + 4 workshops + 2 class tests

Prerequisites: PH300, PH301, PH304

Aims: To provide a basic but rigorous grounding in observational, computational and theoretical aspects of astrophysics to build on the descriptive course in Part I, and to consider evidence for the existence of exoplanets in other Solar Systems.

Learning Outcomes:

1. An understanding of the fundamentals of making astronomical observations across the entire electromagnetic spectrum, including discussion of photometry and spectroscopy, and the physics of the astrophysical radiation mechanisms.
2. An understanding of the motions of objects in extrasolar systems and the basic techniques required to solve the 2-body problem to measure their properties.
3. An understanding of observational characteristics of stars, and how their physical structures are derived from observation and using simple physical models.
4. To be able to discuss coherently the origin and evolution of Stellar and Planetary Systems.

SYLLABUS:

Observing the Universe [15 lectures]
Telescopes and detectors, and their use to make observations across the electromagnetic spectrum. Basic Definitions: Magnitudes, solid angle, intensity, flux density, absolute magnitude, parsec, distance modulus, bolometric magnitude, spectroscopic parallax, colour-colour diagrams. Stellar Photometry: Factors affecting signal from a star. Detectors: Examples, Responsive Quantum Efficiency, CCD cameras. Filters, UBV system, Colour Index as temperature diagnostic.

Extra Solar Planets [6 lectures]
The evidence for extrasolar planets will be presented and reviewed. The implications for the development and evolution of Solar Systems will be discussed.

Astrophysics [15 lectures]
Basic stellar properties, stellar spectra. Stellar structure: description of stellar structure and evolution models, including star formation, nucleosynthesis and burning chains. Stellar motions: Space velocity, proper motion, radial velocity, Local Standard of Rest, parallax. Degenerate matter: concept of degenerate pressure, properties of white dwarfs, Chandrasekhar limit, neutron stars, pulsars, Synchrotron radiation, Schwarzschild radius, black holes, stellar remnants in binary systems.

Assessment Methods: Examination 70%, Homework 10%, 1^{st} class test 10%, 2^{nd} class test 10%.

Recommended Texts:
Carroll & Ostlie, An introduction to Modern Astrophysics, Addison-Wesley, [QB461]

[Note: Changes may occur to the syllabus during the year**]**

SPACECRAFT DESIGN AND OPERATIONS **PH508**

School of Physical Sciences Convenor Dr. M.J. Burchell ECTS Credits 7.5
Taught in Autumn & Spring term Kent Credits 15 at Level I

Prerequisites: PH300, PH301, PH304 **Co-requisites**: None

Aims:

(1) To provide a basic understanding of the major subsystems of a spacecraft system.
(2) To provide basic frameworks for understanding of spacecraft trajectory and orbits, including interplanetary orbits, launch phase and attitude control.
(3) To provide an awareness of the basic ideas of how space is a business/commercial opportunity and some of the management tools required in business.

Learning Outcomes (Subject specific):

After completing the module, students should be able to: (4) Understand the way in which space missions are configured both from the point of view of the constituent subsystems and the mission profile including the influence of the space environment. (5) Appreciate the constraints and trade-offs which have led to particular mission configurations. (6) Be able to look at space activities from a commercial viewpoint and be familiar with basic management tools for planning work.

Learning Outcomes (Generic):

(7) Ability to identify relevant principles, make relevant approximations and solve problems using a mathematical approach.

Teaching Provision: 36 contact hours (30 lectures, 4 workshops, 2 class tests). In addition 114 hours of self study are required. The lectures will introduce students to the material and guide them through it (aims 1 → 3), self study, homework and the workshops will provide deeper understanding and comprehension (outcomes 4 → 7).

SYLLABUS:

Low Earth Orbit Environment [4 lectures]

The vacuum, radiation etc environment that a spacecraft encounters in Low Earth Orbit is introduced and its effect on spacecraft materials discussed.

Spacecraft systems [11 lectures & 1 workshops]

A basic introduction to spacecraft and their environment. Covers Spacecraft structures and materials, thermal control, power systems, attitude control systems, the rocket equation and propulsion.

Project management [5 lectures & 1 workshop]

This discusses: The evolving framework in which world-wide public and private sector space activities are conceived, funded and implemented. The basics of business planning and management.

Orbital mechanics for spacecraft [10 lectures & 1 workshop]

Students will find out how basic Celestial Mechanics relates to the real world of satellite/spacecraft missions. Following an overview of the effects of the Earth's environment on a satellite, the basic equations of motion are outlined in order to pursue an understanding of the causes and effects of orbit perturbations. A description is given of different types of orbit and methods are outlined for the determination and prediction of satellite and planetary orbits. Launch phase is also considered, and the module concludes with an assessment of Mission Analysis problems such as choice of orbit, use of ground stations, satellite station-keeping and orbit lifetimes.

Class tests [2, each one hour]. Each test will cover approximately half the syllabus.

Assessment Methods: Examination 70%, homework 10%, combined class tests 20% (i.e. 10% each). The exams are to test overall breadth and depth of knowledge and understanding, homework and class test are to encourage learning and comprehension during the course. The assessment will test all learning outcomes (specific and generic).

Recommended Texts:

Fortescue, Stark and Swinerd, Spacecraft Systems Engineering, Wiley (2003) 3rd ed, [TL875, 6 copies]
Roy, Orbital Motion, Adam Hilger, [QB355]

Other useful books:

Griffin and French, Space Vehicle Design, AIAA, [TL875].
Wertz and Larson, Space Mission Analysis and Design, 2nd ed. Kluwer [TL790]
Chetty, Satellite Technology and its Applications, TAB Books, Inc. [TL796]
Wertz, Spacecraft Attitude Determination and Control, Reidel Publishing Co. [TL3260].
Turner, Rocket and Spacecraft propulsion, pub. Praxis [TL782]

[Note: Minor changes may occur to the syllabus during the year**]**

MULTI-MEDIA FOR ASTRONOMY, ASTROPHYSICS & PLANETARY SCIENCE

PH512

School of Physical Sciences   Convenor Prof M Smith   ECTS Credits 7.5
Taught in Spring term   Kent Credits 15 Level I

Teaching Provision: 36 lectures including console sessions

Prerequisites: PH300, PH301, PH304

Aims:

This module focuses on the use of Multimedia techniques applied to astronomical data, and data processing. There will be 36 hourly sessions made up of a combination of lectures and practical use of the software.

Learning Outcomes:

Students will become able to: use the web to access and process astronomical data available on the internet, create, use enhance digital and astronomical format images, learn how to use astronomical image processing packages, carry out searches of astronomical databases on the web, and develop familiarity with the topics set out in the Lecture syllabus below, both as taught material, and by use of computer exercises to illustrate them. These objectives relate to learning outcomes including key skills for employment, learning to access data, the internet and multimedia libraries, and development of practical skills in data collection and reduction. There will be 36 contact hours made up of a mixture of formal lectures and console sessions. 75 self study hours will be required, plus 39 hours on set exercises and practise. The combination of lectures, console sessions and self study will introduce material, demonstrate its use to students and then let them attempt its use themselves

SYLLABUS:

Lectures and workshops [36 classes]

The lectures will include a substantial amount of practical material to teach you the use of software tools integrated in with the Lecture Material.Topics covered will include:
Use of Virtual Observatories and Grids for accessing astronomical databases; astronomical image format; use of software packages for data analysis.
Color Imaging: Learn color theory and color practice
CCD cameras, astronomical images and data analysis techniques
Image Analysis: Quantifying digital imagery
Astrometry: Measuring coordinates of celestial objects from images
Photometry: Determining magnitudes of variable stars
Spectroscopy: studying the wavelength dependence.

Assessment Methods: 100% coursework including weekly console exercises and various assignments.

Recommended Texts:

The Handbook of Astronomical Image Processing (http://www.willbell.com/aip/index.htm)

[Note: Changes may occur to the syllabus during the year**]**

MEDICAL PHYSICS **PH513**

School of Physical Sciences Convenor Dr. C.J. Solomon ECTS Credits 7.5
Taught in Spring term Kent Credits 15 Level I

Teaching Provision: 28 lectures, 2 class tests, Hospital visit.

Aims:
1. To provide a broad overview of the role of physics and the physicist in modern medicine.
2. To set out the physical and mathematical essentials of major diagnostic and therapeutic techniques.

Learning outcomes:
1. An understanding of the underlying physical principles in diagnostic radiology, nuclear medicine, magnetic resonance imaging and ultrasound.
2. An acquaintance with current instrumentation.
3. Some appreciation of the factors involved at the physical/biological interface in treatment and diagnosis.

SYLLABUS:
The module involves several contributors from the Department of Medical Physics at the Kent and Canterbury Hospital.

Imaging and computed tomography [8 lectures]
Radiation detection. Spatial, energy and time resolution. Theory of Image formation. Point-spread function and convolution. Fourier transform and spatial frequency representations. Transfer functions and Filters. Transmission computed tomography – theory, practical considerations, imaging systems. Emission Computed tomography – SPECT and PET, technical comparison, applications and limitations.

Diagnostic Radiology [4 lectures]
Basic radiographic imaging systems, including the process of X-ray production and control, beam geometry collimation and filtration, scatter rejection, film-screen image receptors and film processing. Coverage is then given of the design of X-ray image intensifiers used for real-time and static (digital) imaging, and a range of specialised techniques is described including mammography (breast imaging), conventional tomography and scanned beam radiography. The overview of imaging systems is then completed with a description of the design and operation of scanners using computed with a description of the design and operation of scanners using computed assisted transmission tomography and nuclear magnetic resonance. Insights will be given into the role of the physicist in healthcare.

Nuclear Medicine [4 lectures]
The basis for the production of diagnostic information and the implementation of specialised radiation therapy. Production of suitable radionuclides for nuclear medicine applications. The design and operation of the gamma camera as a primary means to detect radiation from the patient. Single proton emission tomography and tomography based on positron emission. Therapy concepts.

Optical Techniques in Medicine [4 lectures]
A short introduction on optical tissue properties at visible and infrared wavelengths. Confocal microscopy and optical coherence tomography. Applications in ophthalmology, dermatology and biology. Spatial resolution, signal to noise ratio, investigative time and safety levels.

Magnetic Resonance Imaging [4 lectures]
An outline of the basic principles of magnetic resonance from both quantum and classical points of view. Requirements for detecting nmr signals including a schematic spectrometer design. Introduction to spin-lattice and spin-spin relaxation and their practical effects on signal observation. Their importance in biological tissue characterisation. Spatial identification using magnetic field gradients and basic imaging methods and image reconstruction in nmr. Medical imaging apparatus and some clinical examples of applications.

Ultrasound [4 lectures]
Interactions of ultrasound in the body: specular reflection, diffuse scattering, and mechanisms for significant energy transfer or cell disruption relevant to therapy. The design and operation of ultrasound imaging systems, including pulse-echo principles and multi-element probe design. Signal processing and image analysis and interpretation. Introduction to the range of ultrasound systems designed for physiotherapy and surgery.

Hospital visit: 2 hour tour of facilities at the Kent and Canterbury Hospital

Assessment Methods: Examination 70 %, Coursework 30% (Homework 10%, 2 Class tests @10%)

Recommended Text:
Webb, The Physics of Medical Imaging [R857.06]
Supplementary reading:
Barrett and Swindell, Radiological Imaging [RC78]
(This is very comprehensive but rather mathematical in parts)
J D. Regan and J. A. Parrish, "The Science of Photomedicine", Plenum Press,
New York and London, 1982, from the Photobiology Series edited by K. C. Smith.

PHYSICS LABORATORY IIA

PH520

School of Physical Sciences   Convenor Dr G Mountjoy   ECTS Credits 7.5
Taught in AutumnTerm   Credits 15 Level I

NOTE: This is a single unit module which contains a subset of experiments from PH500.

Pre-requisites: PH300 and PH301.

Aims:

To learn essential practical aspects of Physics as defined in the learning outcomes (see below), and to observe physical phenomena and experimental demonstrations of physical laws.

Learning Outcomes:

1. To carry out experiments, analyse the results (including uncertainty), and draw conclusions.
2. A familiarity with experimental equipment and procedures.
3. The systematic and reliable recording of experimental data.
4. An ability to use mathematical techniques to model physical phenomena.
5. To present and interpret information graphically.
6. To use computers for retrieval of information and analysis of data.
7. To communicate scientific information, in particular to produce scientific reports.
8. Transferable skills - problem-solving, investigative (independent use of reference materials), communicative, analytical, and personal.

SYLLABUS:

Most practicing physicists at some point will be required to perform experiments and take measurements. This module, through a series of experiments, seeks to allow students to become familiar with some more complex apparatus and give them the opportunity to learn the art of accurate recording and analysis of data. This data has to be put in the context of the theoretical background and an estimate of the accuracy made. Keeping of an accurate, intelligible laboratory notebook is most important. Each term three two week experiments are performed. The fourth two week period is allocated to some additional activities to develope experimental and communications skills.

Teaching Provision: There will be 6 x 7hr laboratory sessions in Term 1. This module is expected to occupy 150 total study hours, including the aforementioned contact hours.

Assessment Methods: Coursework 100%. Three laboratory reports (Type 1), one communications exercise, and one extended report (Type 2) are required at the end of AutumnTerm.

Core Text: Kirkup L., *Experimental Methods* [Q182.3, 3 copies]
(John Wiley and Sons, 1994, ISBN 0471335797, paperback, approx. £13.)

Recommended Texts: Taylor J.R., *An Introduction to Error Analysis* [QA275, 8 copies]

PHYSICS 3rd Year MPhys PROJECT — PH600

School of Physical Sciences Convenor Dr. C.J. Solomon ECTS Credits 7.5
Taught in Autumn and Spring terms KentCredits 15 Level H

Teaching Provision: 15 (6 hour) laboratory days

Prerequisites: PH500

Aims:

1. To provide either
   i) experimental or theoretical projects to give an introduction to scientific research procedures, or
   ii) experience of the process of critical scientific review, or
   iii) experience of the development of teaching or Public Understanding of Science material.
2. To deepen knowledge in a specialised field and be able to communicate that knowledge orally and in writing.

Learning Outcomes:

1. Ability to work within a small group (co-worker and supervisor) on an experimental, theoretical, computing or data analysis problem.
2. An appreciation of the procedures involved in scientific research including writing a report in the style of a scientific paper.

This module is meant for intending MPhys students in their 3rd Year. Projects run for roughly one and a half terms. Work may be undertaken individually or in pairs, and there is one laboratory day (11am - 5 pm) per week timetabled.

A choice of projects will be made available at the start of the Autumn term, to include such activities as experimental measurement and observation, the analysis of scientific information, the design and construction of electronic devices, the implementation and development of computational methods, the review of topics of current scientific interest, and the development and evaluation of new teaching aids.

Students produce a written report by the end of week 15, and they are given a viva on this in the latter part of the Spring term.

Assessment: Diligence and Progress on project: 25%, Written Report: 50%, Viva: 25%

Recommended Texts: Appropriate background reading will depend on the topic of the project and will be suggested by individual project supervisors.

PHYSICS PROBLEM SOLVING — PH602

School of Physical Sciences Convenor Prof P Strange ECTS Credits 7.5
Taught in Spring Term Kent Credits 15 Level H

Teaching Provision: 10 classes, 2 essays, 1 lecture + 1 feedback class, (essay writing), 1 mock exam

Prerequisites: A general knowledge of undergraduate physics is assumed

Aims: After taking the classes students should be more fluent and adept at solving and discussing general problems in Physics.

Subject-specific Learning Outcomes:
1. Knowledge and understanding of physical laws and principles of basic physics and their applications to diverse areas of physics. Revision of many areas of basic physics (e.g. thermodynamics, classical mechanics, optics, simple harmonic motion, etc.) Improved familiarity with estimating quantities, considering if a derived answer is physically plausible, how to approach problems where the physics content is not flagged in advance (i.e. when the question does not start by saying "Using the Perfect Gas law...), the magnitudes of things (sizes of atoms, nuclei, etc.).

Generic Learning Outcomes:
1. An improved ability at presenting written discussions of scientific topics.
2. An appreciation of how the theoretical formalism is related to experimental observations.
3. Ability to: identify relevant principles and laws when dealing with problems of atomic and nuclear physics and to make approximations necessary to obtain solutions; solve problems of atomic and nuclear physics using appropriate mathematical tools; make use of appropriate texts or other learning resources as part of managing their own learning.
4. Problem-solving skills, in the context of both problems that are well-defined or open-ended problems.
5. Analytical skills – associated with the need to pay attention to detail, to construct logical arguments and to use technical language correctly.
6. Competent use of appropriate C&IT packages /systems for the retrieval of appropriate information.

SYLLABUS:

Workshops:
The module consists of classes where the students work in small groups on set problem sheets. The problem sheets contain either old exam questions, questions in the style of old exam questions or classical general problems in physics. The idea of working in small groups is that students can talk to each other, stimulating each other's work and supporting one another as they learn the techniques necessary to solve general problems. A member of staff and an assistant will attend each class and offer advice as needed.

Mini-project and Essays:
A small research problem will be set for students to solve. An essay will be set on general science or physics topics. Tuition in scientific essay writing will be provided.

Total study hours expected of students: 150 hours

Assessment Methods: Examination 60% Coursework 40% (Examples 15% mini-project: 10% Essay 2: 15%). Examination and coursework will test the learning objectives 1,3, 4, 5. Essay writing will test the learning objectives 2, 6 and 7.

Recommended Texts:
Background reading: Oman and Oman, Physics for the Utterly Confused, McGraw Hill [QC23]; Barrass, Scientists Must Write, Routledge [Q223]

Minor changes may occur to the syllabus during the year

PHYSICS GROUP PROJECT — PH603

School of Physical Sciences Convenor Prof. R.J. Newport ECTS Credits 7.5
Taught in term 1 (weeks 11 & 12 only) and term 2 KentCredits 15 Level H

Teaching provision:- Introductory seminars followed by both specified and *ad hoc* group meetings and supported throughout by a rolling e-mail backup route.

Prerequisites:- None

Aims

a) To provide opportunity for students to work together as a team on a single project.
b) To plan, research and conduct a short programme of work within a defined topic, and
c) to present the results to a wider community *via* both written and oral reports.

Module-specific learning outcomes

1. Students will have the opportunity to develop their inter-personal skills and their ability to engage in effective team-work through collaborative action.
2. Students will acquire basic project management experience through the organisation, planning and implementation of the different elements of the programme.

Intellectual and subject-specific learning outcomes

3. An ability to identify relevant principles and laws when dealing with problems, and to make approximations necessary to obtain solutions.
4. An ability to present and interpret information graphically.
5. An ability to communicate scientific information, in particular to produce clear and accurate scientific reports.
6. An ability to make use of appropriate texts, research-based materials or other learning resources as part of managing their own learning.
7. Problem-solving skills, in the context of both problems with well-defined solutions and open-ended problems; an ability to formulate problems in precise terms and to identify key issues, and the confidence to try different approaches in order to make progress on challenging problems. Numeracy is subsumed within this area.

Transferable skills learning outcomes

8. Problem-solving skills, in the context of both problems with well-defined solutions and open-ended problems; an ability to formulate problems in precise terms and to identify key issues, and the confidence to try different approaches in order to make progress on challenging problems. Numeracy is subsumed within this area.
9. Investigative skills in the context of independent investigation including the use of textbooks and other available literature, databases, and the interaction with colleagues to extract important information.
10. Communication skills in the area of dealing with surprising ideas and difficult concepts, including listening carefully, reading demanding texts and presenting complex information in a clear and concise manner. C&IT skills are an important element to this.
11. Analytical skills – associated with the need to pay attention to detail and to develop an ability to manipulate precise and intricate ideas, to construct logical arguments and to use technical language correctly.
12. Personal skills – the ability to work independently, to use initiative, to organise oneself to meet deadlines and to interact constructively with other people.

Syllabus

The introductory seminars cover the general objectives of the module and a presentation of the specific topics available in the current year (students are explicitly encouraged to offer alternate topics provided they are able to secure the agreement of the module convenor). Additional seminars provide opportunities to discuss and share ideas, and to introduce what is needed within a successful presentation (the presentations are filmed, and the resulting DVD used for detailed feedback). There is a distinct 'role play' element to the conduct of the module. Students *may* be given the opportunity to define their own groupings provided that there is overall agreement within the peer group, but the convenor will retain the right to define both the overall parameters (e.g. the number of students to be in each group) and the final assignment of students into groups if that proves to be necessary. Students then make a choice of topic and elect their group project manager. The groups arrange their own regular meetings, which will be minuted; the supervisor <u>may</u> be present at these sessions. The group will produce a word-processed report on the work undertaken; it will also present the work in an appropriate 'public' form (i.e. depending on the nature of the project undertaken – a lecture, multi-media presentation, …). The group's presentation will be augmented by the production of a poster designed to convey the essence of their work to a lay audience. The report will include a statement on the group's project methodology, presented in the context of an initial draft work plan and tasks assignment as well as a statement describing the individual contributions to the group's aims and objectives.

Project themes
The themes vary widely depending on student preferences/interests, but for example could fall in one of the following general categories:

- off-campus interactions, such as working with a school physics group or small business in the local area;
- the production of an instruction booklet, teaching aid or video aimed at a pre-define audience;
- a design project for a piece of instrumentation or a computational code;
- a survey or analysis of a physics-centred contemporary issue of scientific, social, political or ethical interest or concern;
- the input of physics to interdisciplinary issues such as those associated with environmental or conservation science.

Learning & teaching methods
Seminars (4h) – provide the opportunity to discuss and understand the nature and the requirements of a <u>group</u> project;
Lecture (1h) – to provide an outline of what is expected and required in the context of the project presentation;
Presentation and feedback (~4h) – to provide the opportunity to present the group's work, and subsequently to replay the recording of the project presentation in order to provide the opportunity for self-appraisal and the sharing of best practice;
Personal and ICT-based support for project managers – from the convenor, to provide advice to the groups via their respective manager;
Intra-group project planning and implementation meetings (~41) – provide the opportunity for the group to work towards and finalise the synthesis of their final output;
Private study – to provide the opportunity for the individual student to generate material towards the work of the group and according to the group's work plan/task list (~100h)

Assessments methods
Coursework 100%
The assessment will be based on the final report (60%, including prescribed appendices) and the presentation (40%, will includes the supplementary poster and also comprises an element of peer review). The mark is awarded on a group basis (i.e. all members of the group receive the same mark) but some adjustments on a 'zero sum' principle may be made to individual marks on the basis of student group and supervisor/convenor feedback regarding relative contributions. Each group is given the opportunity to assess the talks presented by the other groups; this peer assessment is regarded as an integral element of the overall module training.

Recommended texts:-
None.

RELATIVITY, OPTICS AND MAXWELL'S EQUATIONS **PH604**

School of Physical Sciences Convenor Dr. C.J. Solomon ECTS Credits 7.5
Taught in Autumn term KentCredits 15 Level H

Teaching Provision: 34 lectures including workshops + 2 class tests
Prerequisites: PH301, PH504

Aims:
1. To provide an introduction to special relativity.
2. To develop knowledge of the fundamental principles of optics.

Learning Outcomes:
1. Knowledge and understanding of physical laws and principles of special relativity and optical phenomena and their applications. An appreciation of how the theoretical formalism is related to experimental observations.
2. Ability to: identify relevant principles and laws when dealing with problems of special relativity and optical phenomena and to make approximations necessary to obtain solutions; solve problems of special relativity and modern optics using appropriate mathematical tools; make use of appropriate texts or other learning resources as part of managing their own learning.
3. Problem-solving skills, in the context of both problems with well-defined solutions and open-ended problems of special relativity and modern optics.
4. Analytical skills – associated with the need to pay attention to detail, to construct logical arguments and to use technical language correctly.

SYLLABUS:
Special Relativity [12 lecture sessions]
Failure of attempts to detect aether, apparent constancy of velocity of light *in vacuo*, Einstein's Principle of Relativity, Lorentz contraction, time dilation, simultaneity, Lorentz transformation of events, Minkowski space, relativistic formulation of physical laws – Lorentz scalars and 4-vectors – scalar d'Alembertian operator – relativistic Doppler effect – mechanics – generalisation of mass, momentum and energy, 4-velocity and 4-momentum, conservation of 4-momentum applied to particle kinematics – $E = mc^2$, invariance of $E^2 - p^2 c^2$, photons, Compton effect - decay of π-meson - 4-vector nature of Maxwell's equations (brief).
Maxwell's Equations and Fourier Optics: **[14 lecture sessions]**
Mathematical preliminaries, Dielectric media and dielectrics, Maxwell's equations and their relationship to other laws of electromagnetism, displacement current, Poynting's theorem and energy in electromagnetism, plane waves, EM plane wave solutions in free space, effect of dielectric media, EM boundary conditions, vacuum-dielectric interface, normal incidence, general angle of incidence, Snell's law, Fresnel coefficients, Brewster's angle, critical angle and total internal reflection, reflection and transmission coefficients, double boundaries.
Huygens-Fresnel principle, Far-field, Far-field with lens, Transform calculations, optical system quality, optical transfer function.
Modern Optics [8 lecture sessions]
POLARISATION: Birefringence (mechanical oscillator model, evolution of polarisation, waveplates, polarisers, double refraction, circular birefringence), Jones calculus.
OPTICAL FIBRE TECHNOLOGY: Approximate analysis of slab waveguide leading to discussion of properties of waveguide modes, extension to optical fibres, single and multimode fibres, modal dispersion, waveguide and material dispersion, fibre loss, fibre construction.

Assessment Methods: Examination 70%, Coursework 10%, Class tests: 20%. Each class test counts for 10%. Two class tests will assess the learning objectives related to Maxwell's Equations, Fourier Optics and Modern Optic. One class test will assess the learning objectives related to Special Relativity.

Total study hours expected of students: 150 hours

Core Texts:

D.J. Griffiths, Introduction to Electrodynamics, 3rd Ed. (1999), Prentice Hall
E. Hecht, Optics 3rd Edn., Addison Wesley, [QC375.2]
J. Wilson and J.F.B. Hawks, Optoelectronics: An Introduction, Prentice-Hall International, 1983.[QC 447]
A.Yariv, Optical electronics, Holt-Saunders International, 1985. [QC 447]
G. Barton, Introduction to the Relativity Principle, J. Wiley & Sons, 1999.

URL: http://www.kent.ac.uk/physical-sciences-local/teaching-materials/physics.htm

THERMAL AND STATISTICAL PHYSICS **PH605**

School of Physical Sciences   Convenor Dr G Dobre   ECTS Credits 7.5
Taught in Autumn and Spring terms   Kent Credits 15 Level H

Teaching Provision: 32 lectures, 4 workshops, 2 class tests
Prerequisites: PH300, PH301, PH502

Aims:
1) To provide an introduction to basic thermodynamics with applications
2) To explore the statistical basis of thermodynamics
3) To develop the subject of quantum statistics

Learning Outcomes:
Generic: Improve one's own learning and performance; problem solving; transferable skills - problem solving and analytical
Subject specific:
To know and understand physical laws (as applied to thermal and statistical physics)
To mathematically describe physical phenomena
To solve problems using relevant laws and approximations
To solve problems using appropriate mathematical techniques
To graphically present and interpret information about physical phenomena
To use appropriate texts as part of self-directed learning

SYLLABUS:
1. Thermodynamics [12 lectures]
Review of zeroth, first, second laws. quasistatic processes, functions of state, extensive and intensive properties, exact and inexact differentials, concept of entropy as a function of state. Heat capacities, thermodynamic potentials: internal energy, enthalpy, Helmholtz and Gibbs functions. The Maxwell relations. Concept of chemical potential. Applications to simple systems. Joule free expansion, Joule-Kelvin effect, Equilibrium conditions; phase equilibria, Clausius-Clapeyron equation. The third law of thermodynamics and its consequences – inaccessibility of the absolute zero.
2. Statistical Basis of Thermodynamics [4 lectures]
Distribution of the energy eigenstates of a many-body system. Density of states, $\omega(E,N)$, and $S = -k_B \ln\omega(E,N)$. Introduction to the partition function, concepts of statistical microstates and macrostates, counting the microstates, ergodicity, explicit examples for simple systems.
3. Basic Statistical Concepts [6 lectures]
Isolated systems and the microcanonical ensemble. Boltzmann's theory and distribution; statistical weights. Systems in thermal equilibrium and the canonical ensemble. Single particle partition function and Z_N for localized particles; relation to Helmholtz function and other thermodynamic parameters. Spin-half system and paramagnetism.
4. Semi-classical Physics [6 lectures]
Partition function for the semi-classical perfect gas, distinguishable and indistinguishable particles. Density of states. Contributions of different molecular motions (translation, rotation and vibration) to the partition function. Heat capacities, equipartition principle and Sackur-Tetrode equation. Validity and limits of the semi-classical description.
5. Quantum Statistics[4+ lectures]
Concepts of quantum statistics (Fermions, Bosons, Pauli-exclusion principle). The different statistics: Fermi-Dirac and Bose-Einstein. Use of the Grand partition function and thermodynamic potential. Properties of the ideal quantum Fermi and Bose fluids, Bose-Einstein condensation. Λ-point in liquid ^{4}Helium, superfluidity. Ideal solids (phonons and photons, Einstein and Debye-theory). Free electrons in metals, Fermi-energy, photon gas and black-body radiation.

Learning and teaching methods: There will be 32 lectures and 2 class tests in Term 1 and 2 revision lectures in Term 2. This module is expected to occupy 150 total study hours, including the aforementioned contact hours.

Assessment Methods: Examination 70%, 2 Class Tests 20%, Coursework 10%.

Recommended Texts:
part 1 & 2: C.J.Adkins: *"Equilibrium Thermodynamics"*, Cambridge University Press, [QC 311 4 copies]
part 3 & 4: F. Mandl, *"Statistical Physics"*, Wiley, 1988 [QC175, 17 copies]
R. Baierlein: *"Thermal Physics"*, Cambridge University Press, 1999 [QC 311 10 copies]

SOLID STATE PHYSICS — PH606

School of Physical Sciences Convenor Dr. G. Mountjoy — ECTS Credits 7.5
Taught in term 1 — Kent Credits 15 Level H

Teaching provision:- 34 lectures + 2 class tests

Prerequisites:- PH300, PH301, PH502

Aims

a) To provide an introduction to the study of solid state physics.
b) To build foundations for the study of the physics of materials, and condensed matter in general.
c) To set out the underlying physics for solid state electronic and opto-electronic devices.

Module-specific learning outcomes

1. An increased understanding of the nature and structure of different types of solid materials, including magnetic materials, and how these may be studied.
2. An understanding of the band structure of conducting materials.
3. The ability to explain the operation of simple semi-conductor devices in terms of band structure concepts.

Intellectual and subject-specific learning outcomes

4. Knowledge and understanding of physical laws and principles, and their application to diverse areas of physics (this will include electromagnetism, classical and quantum mechanics, statistical physics and thermodynamics, wave phenomena and the properties of matter as fundamental aspects, with additional material from nuclear and particle physics, condensed matter physics, materials, plasmas and fluids; see module syllabuses for details).
5. An ability to use mathematical techniques and analysis to model physical behaviour.
6. An ability to present and interpret information graphically.
7. An ability to make use of appropriate texts, research-based materials or other learning resources as part of managing their own learning.

Transferable skills learning outcomes

8. Problem-solving skills, in the context of both problems with well-defined solutions and open-ended problems; an ability to formulate problems in precise terms and to identify key issues, and the confidence to try different approaches in order to make progress on challenging problems. Numeracy is subsumed within this area.
9. Analytical skills – associated with the need to pay attention to detail and to develop an ability to manipulate precise and intricate ideas, to construct logical arguments and to use technical language correctly.

Syllabus

Atomic-scale structure [~8 lectures, TBA]
Definitions, crystal types; order-disorder characteristics, amorphous materials, lattice properties, Miller indices. Diffraction formalism, scattering vector, Δk; Laue equations, 1D, 2D & 3D conditions. Diffraction methods; neutron and X-ray scattering methods, structure factor. Reciprocal lattice, Brillouin zone. Experimental techniques, reactors and synchrotron radiation sources.

Atomic-scale dynamics [~7 lectures, TBA]
Interaction potential for atoms and ions. Lattice dynamics for 1D monatomic and diatomic arrays, phonon dispersion curves, acoustic and optical modes of vibration; experimental techniques, triple-axis spectrometer and Brillouin light scattering. Lattice specific heats [brief]. Phonon propagation and heat conduction, thermal expansion and anharmonicity effects.

Electrons in k-space: metals [~9 lectures, Bob Newport]
Free electron theory of metals. The metallic bond. Allowed k states for particles in a box. Density of states. Fermi-Dirac distribution. Fermi energy of a simple metal. Electronic specific heat. Band theory of solids - introduction of a weak periodic potential. Bloch's theorem. Concept of 'first Brillouin zone' and extended zone scheme. Relationship with reciprocal lattice. The Wigner-Seitz construction for the first Brillouin zone. Effective mass. Concept of a 'hole'. Distinction between metals and insulators. Band overlap. Determination of the electrical properties of metals; electrical conductivity according to classical (Drude) and quantum theory. Hall effect and cyclotron resonance. Effective masses again.

Band gaps and holes: semiconductors [~5 lectures, TBA]

Band structure of ideal semiconductor. Simplified band structure of Si. Cyclotron resonance and Hall effect in semiconductors. Carrier mobility. Density of states and electronic/hole densities in conduction/valence band. Intrinsic carrier density. Position of chemical potential. Doped semiconductors. Derivation of majority and minority carrier densities. Derivation of $n_e n_h = n_i^2$. Elementary treatment of p-n junction and 'diode equation'; depletion width, junction capacity.

Coherent spin: magnetism [~5 lectures, TBA]
Definitions of B, H, χ, dia, para, ferromagnetism. magnetic moments, electron g-factor. General treatment of paramagnetism, Brillouin function. Curie's law. Electron spin paramagnetism. Ferromagnetism: Einstein-de Haas expt.. Introduction to ferromagnetism and the exchange interaction. Weiss internal field model. Curie temperature. Domains.

Learning & teaching methods
Lectures (34h) – provide the opportunity to learn and understand the theory and knowledge required;
Intra-module tests (2h) – provide the opportunity to assess the degree to which you have learned and understood the theory and knowledge required;
Intra-module weekly assignments (8) – provide the opportunity to assess the degree to which you have learned and understood the theory and knowledge required;
Private study and revision (~100h)

Assessment Methods
Examination 70%, Coursework (assessed via 2 intra-module exams and a series of weekly problems, 30%)

Recommended Texts
Hook & Hall, *Solid State Physics*, Wiley [QC176]
Additional texts:
Kittel, *Solid State Physics* (7th Ed), Wiley, 1996 [QC176]
Ashcroft & Mermin, *Solid State Physics*, Holt-Saunders [QC176]

[Note:- Changes may occur to the syllabus, the lecturers and the teaching matrix during the year**]**

STARS, GALAXIES AND THE UNIVERSE **PH607**

School of Physical Sciences Convenor Prof M Smith ECTS Credits 7.5
Taught in Spring term Kent Credits 15 Level H

Prerequisite and co-requisite modules: PH300, PH301, PH304, PH507, PH604

Aims: To provide, in combination with PH507, a balanced and rigorous course in Astrophysics for B.Sc. Physics with Astrophysics students, while forming a basis of the more extensive M.Phys. modules.

The intended subject specific learning outcomes:
a) Knowledge of the internal structure of stars and how they are derived, the processes by which energy is produced and transferred within them and the properties of the possible evolutionary end states.
b) An understanding of the fundamentals of general relativity and its use in understanding the properties and evolution of the universe.
c) An understandings of the structure and evolution of the universe, from individual stars, to galaxies and the universe itself.

Syllabus
a) Physics of Stars [17 lectures + 2 workshops]
Review of hydrostatic and thermal equilibrium, use to calculate stellar properties; Virial theorem and timescales. Radiative equilibrium, radiation and conduction, energy sources; Fission and fusion. Nucleosynthesis: PPI, PPII, PPIII chains; CNO cycle, Triple-alpha process; elemental abundances; Solar neutrino problem. Post main sequence evolution; Convection; Conditions for convective instability; Convective vs radiative energy transport for stars of different mass; Stellar structure equations and description of techniques for solutions; formation of binary stars and disks; estimation of mass transferring rate from disk to stars.
b) Galaxies [8 lectures + 1 workshop]
Hubble classification of galaxies; Luminosity function; Distrubution of galaxies in space; Mass and dynamics of galaxies; Interpretation of spiral and elliptical galaxies. Active galaxies, Quasars; Observational properties.
c)General Relativity and Cosmology [5 lectures + 1 workshop]
Inadequacy of Newton's Laws of Gravitation, Principle of Equivalence; Non-Euclidian geometry; Curved surfaces; Cosmological model of a closed universe; Metric tensor; Schwarzschild solution; Gravitational redshift; Brief summary of the precession of Mercury's perihelion and the bending of light; black holes; Brief survey of the universe; Robertson-Walker metric, field equations for cosmological and critical density; Friedmann models; The early universe.

Assessment Methods:
Examination 70%, coursework 10%, class tests 20%.

Recommended Texts:
Calloll & Ostlie, Modern Astrophysics, Addison Wesley [QB461]
Useful background reading:
Bohm-Vitense, Volume 3; Stellar Structure and Evolution, Cambridge University Press [QB801]
Taylor, The stars: Their structure and Evolution, Cambridge University Press. [QB801].
Berry, Principles of Cosmology and Gravitation, Adam Hilger. [QB891]
Roos, Introduction to Cosmology, Wiley. [QB891]

[Note: Minor changes may occur to the syllabus during the year]

THE SUN, THE EARTH AND MARS **PH608**

School of Physical Sciences Convenor Dr. J. Miao ECTS Credits 7.5
Taught in Spring Term Kent Credits 15 Level H

Prerequisite and co-requisite modules: PH300, PH301, PH304, PH508

Aims:

a) To gain an appreciation of the physical properties and processes of the sun, and its interaction with the Earth's environment.
b) To study how spacecraft are used with the Earth's environment for specific purposes and that instruments they can carry.
c) To be able to take a critical look at a current field of planetary exploration (Mars).
d) To understand impact hazards to spacecraft.

Learning outcomes:

a) To understand the Sun's emissions and its properties, and its effects on the Earth's atmosphere and the near-Earth space within which spacecraft operate.
b) To have a familiarity with the modes of operation of remote sensing and communications satellites, understanding their function and how their instruments work, know the basic skills for digital image processing.
c) To be familiar with the current space missions to Mars and their impact on our understanding of that planet.
d) To be aware of the significance of hypervelocity impacts and why they are a hazard to spacecraft.

SYLLABUS:

a) Solar Terrestrial physics [10 lectures+1 workshop]
The sun: Overall structure, magnetic field and activity. Interactions with Earth:
plasma physics, solar wind, Earth's magnetic field, ionospheric physics. Terrestrial physics: Earth's energy balance, atmosphere. Space weather, environmental effects, debris.
b) Remote Sensing [10 lectures + 1 workshop]
Modes of operation of remote sensing satellite instruments: radio, microwave, visual and nfrared instruments. Basic uses of the instruments. Digital image processing, structure of digital images, image-processing overview, information extraction. environmental applications: UV radiation and Ozone concentration, climate and weather.
c) Martian Science [6 lectures + 1 workshop]
An overview of recent and future Mars space missions and their scientific aims. Discussions of the new data concerning Mars and the changing picture of Mars that is currently emerging.
d) Impact damage to space craft [4 lectures + 1 workshop]
Introduction to hypervelocity impact physics and the damage that results to spacecraft materials in such impacts.

Assessment Methods:
Examination 70%, coursework 10%, class tests 20%.

Recommended Texts:
Recommended Texts:
Hargreaves, The solar-terrestrial environment, CUP
Elachi, Introduction to the physics and techniques of remote sensing.
Background Reading:
Akasofu, Solar terrestrial physics, Clarendon press [QX9806]
Phillips, Guide to the Sun, CUP[QB521]
W.Rees, Physical Principles of Remote Sensing, CUP[QE501.4]
Sabins, Remote sensing, principles and interpretation[qQH541.15.R4]
Mars, Peter Cattermole, pub. Terra[qQB641]

[Note: Minor changes may occur to the syllabus during the year]

NUMERICAL AND COMPUTATIONAL METHODS **PH611**

School of Physical Sciences Convenor To be announced ECTS Credits 7.5
Taught in Autumn and Spring terms Kent Credits 15 Level H

Teaching Provision: 19 Lectures, ~16 computing console sessions and 2 Tests.

Prerequisites: PH302

Aims:

To introduce the student to some of the more advanced numerical techniques of relevance to physical data analysis and mathematical physics.

To illustrate the practical applications of these techniques with appropriate console sessions with examples scientific programming implemented both in FORTRAN and the high-level symbolic language, MAPLE.

To form an appreciation of the framework of modern electronic structure theory and its implementation

To provide exposure to handling condensed-matter problems using first-principles simulation

Learning outcomes:

Students will have learnt the principles and have had practical experience of utilising some of the most powerful and frequently-used algorithms that are relevant to Physics; particularly for data analysis and for obtaining numerical solutions to analytically intractable problems. They will gain skills in both Fortran and Maple coding.

The ability to outline density-functional theory (DFT) and the local-density approximation

Knowledge of the broad strengths and weaknesses of DFT within the LDA

Knowledge of some key areas of DFT implementations and the supporting condensed-matter theory.

SYLLABUS:

Advanced Numerical Techniques [10 lectures and 10 console sessions]

This will cover the most relevant computational techniques to Physicists. The language used will be FORTRAN (on a UNIX host) and examples will be worked out in console sessions. Topics will include solving linear and non-linear equations, linear and non-linear least-squares fitting of data (including constrained fits and "fit-sensitivities", use of Fourier series and transforms (FFT), quadrature methods (Newton-Coates and Gaussian), eigenvalue (and eigenvector) methods etc.

Introduction to Maple [1 introductory lecture + 5 console sessions + 1 Test]

Workshops cover the use of the commoner features of Maple as applied to Physics e.g. symbolic solution of linear circuit equations, plotting, quadrature, and tidal calculations.

First-principles computer simulation [8 lectures + 1 workshop]

The philosophy and practise of computer simulation. Introduction to implementation. What one can calculate, case studies. Examples will be taken from areas of current research within SPS.

Assessment Methods: Examination 60%, Coursework 30%, Maple Test 10%

Recommended Texts:

Metcalf and Reid, Fortran 90/95 explained [QA76.73.F26]
Press et al , Numerical Recipes (Fortran version) [QA297]
Heal et al, "Maple V Learning Guide", Springer 1998
Richards, D., "Advanced Mathematical Methods with Maple", Cambridge University Press 2002.
"The electronic structure of materials" by A. P. Sutton, Oxford University Press ISBN: 0198517548

PHYSICS LITERATURE REVIEW **PH616**

School of Physical Sciences Convenor Prof M Smith ECTS Credits 7.5
Taught in Spring Term Kent Credits 15 Level H

Teaching Provision: Tutorial sessions (20 hours).

Prerequisites and co-requisites: PH304, PH507, PH508, PH512, PH607, PH608

Objectives:

1. To develop the ability to access and use knowledge contained in published material.
2. To develop the ability to use this to gain insight into astronomical, astrophysical, planetary science related processes.
3. To develop the ability to present scientific information in a logical, coherent, written form.
4. To develop the ability to undertake investigations where, as part of the exercise, the goals and methods have to be defined by the investigator.

Subject-Specific Learning Outcomes:

1. Ability to carry out a scientific literature review and in-depth investigation of a topic.
2. An appreciation of the procedures involved in scientific research including writing reports.

Generic learning outcomes:

1. Ability to summarise complex literature with clarity, succinctness, comprehensiveness, accuracy and good English.
2. Self management and self learning skills

Syllabus

(a) Guide to web based and multimedia libraries.
(b) Introduction to main scientific journals in the field.
(c) Example of how to search a topic and order the information obtained.
(d) Discussion of how to prepare a dissertation.
(e) Tutorial-based guidance through the technical literature.

Learning and teaching methods: tutorials 20h provide opportunities for discussion of module topic. Private study 130h.

Assessment: 100% by coursework. 20% will be from tutorial performance during the module and 80% from the dissertation.

Recommended Texts: None

PHYSICS PROJECT LABORATORY

PH617

School of Physical Sciences   Convenor Dr. J.Miao   ECTS Credits 7.5
Taught in Autumn Term   Kent Credits 15 Level H

Teaching Provision: 12 (6 hour) laboratory days

Prerequisites: PH500

Aims:
1. To provide experience in laboratory based experimentation, data recording and analysis and drawing of conclusions.
2. To develop report writing skills for scientific material
3. To develop the ability to undertake investigations where, as part of the exercise, the goals and methods have to be defined by the investigator.
4. To develop skills in literature searches and reviews.

Learning Outcomes:
1. Ability to work with a partner on an experimental or data analysis problem.
2. An appreciation of the procedures involved in scientific research including writing reports.

Syllabus

The module has two parts
(a) Laboratory experiments. For half the term the students will work in pairs on a series of 3 two-week experiments. A report will be written by each student for each experiment. (Aims 1, 2. Outcomes 1,2).
(b) Mini-projects. For half the term the students will work in pairs on a mini-project. These will be more open-ended tasks than the experiments, with only brief introductions stating the topic to be investigated. A report will be written by each student on their project. (Aims 1, 2, 3, 4. Outcomes 1, 2)

Assessment: 100% by coursework (50% on experiments, 50% on the mini-project)

Recommended Texts: None

Background texts: Taylor J.R., *An Introduction to Error Analysis* [QA275, 8 copies]
Silyn-Roberts, *Writing for Science* [Q223, 1 copy]
Barrass, *Scientists Must Write*, 2nd ed [Q223, 5 copies]

IMAGE PROCESSING **PH618**

School of Physical Sciences Convenor Dr. C. J. Solomon ECTS Credits 7.5
Taught in Spring term Kent Credits 15 Level H

Teaching Provision: 20 lectures, 16 console sessions

Prerequisites: None

Aims:
The aim of this module is to give students knowledge of the key principles of imaging and image processing, to inform them of the real-world applications of the material presented and to provide a learning environment in which some of these principles can be tested and used in a practical way. The students will be introduced to the MATLAB programming language thus allowing them to implement many of the image processing techniques discussed in the lectures.

Learning Outcomes:
An understanding of the principles of image processing and the applications to which it is applied. Knowledge of MATLAB programming and its practical use in console sessions.

SYLLABUS:

Introduction to Matlab **[6 guided console sessions]**

Spatial and frequency domain image processing **[20 lectures and 10 console sessions]**
1. Representation of images and image types. 2. Elementary image operations. 3. Shape in images. 4. Geometric transformations. 5. Warping and morphological transformations. 6. Spatial filtering and its uses. 7. Theory of imaging – PSF and convolution. 8. The Fourier transform and the frequency domain 8. Image quality - spatial resolution, image contrast, point-spread function and Modulation transfer function. 9. Basic Morphological operations and their uses. 10. Image segmentation: edges, colour, texture and shape.
11. Frequency domain filtering. 12. Image restoration and recovery – deconvolution and iterative approaches. 13 Fuzzy logic and systems. 14. Correlation techniques 15. Principal components analysis and uses of statistical methods. 16. Genetic and evolutionary algorithms. 17. pattern recognition. 18. Image Classification. 19. Examples and Case study. 20. Examples and Case study.

Assessment Methods: Examination 60%, Coursework 40%

Recommended Texts:

Gonzalez and Woods, Digital Image Processing, Addison-Wesley, 1992, ISBN 0-201-50803-6 [TJ 223.P4, 6 copies]

John C. Russ, The Image Processing Handbook, CRC Press, 1995 [TA 1632, 2 copies]

D. Hanselman and B. Littlefield, Mastering Matlab 6, Prentice-Hall, 2000, ISBN 0-13-243767-8 [QA 297, 3 copies]

PHYSICS RESEARCH PROJECT **PH700**

School of Physical Sciences Convenor Prof. R.J. Newport ECTS Credits 30
Taught in terms 1 & 2 Kent Credits 60 Level M

Teaching Provision: (Two days per week for 20 weeks)

Prerequisites: PH500 or equivalent

Aims:

a) To provide an experience of research work.
b) To begin to prepare students for postgraduate work towards degrees by research or for careers in R&D in industrial or government/national laboratories.
c) To deepen knowledge in a specialised field and be able to communicate that knowledge orally and in writing.

Intellectual and subject-specific learning outcomes:

1. An ability to identify relevant principles and laws when dealing with problems, and to make approximations necessary to obtain solutions.
2. An ability to plan an experiment or investigation under supervision and to understand the significance of error analysis.
3. Competent use of appropriate C&IT packages/systems for the analysis of data and the retrieval of appropriate information.
4. An ability to present and interpret information graphically.
5. An ability to communicate scientific information, in particular to produce clear and accurate scientific reports.
6. An ability to make use of appropriate texts, research-based materials or other learning resources as part of managing their own learning.
7. An ability to communicate complex scientific ideas, the conclusion of an experiment, investigation or project concisely, accurately and informatively.
8. An ability to make use of research articles and other primary sources.

Transferable skills learning outcomes:

9. Investigative skills in the context of independent investigation including the use of textbooks and other available literature, databases, and the interaction with colleagues to extract important information.
10. Communication skills in the area of dealing with surprising ideas and difficult concepts, including listening carefully, reading demanding texts and presenting complex information in a clear and concise manner. C&IT skills are an important element to this.
11. Analytical skills – associated with the need to pay attention to detail and to develop an ability to manipulate precise and intricate ideas, to construct logical arguments and to use technical language correctly.
12. Personal skills – the ability to work independently, to use initiative, to organise oneself to meet deadlines and to interact constructively with other people.

Syllabus

All MPhys students undertake a laboratory/computationally-based project related to their degree specialism. These projects may also be undertaken by Diploma students. A list of available projects is published by week 1. As far as possible, projects will be assigned on the basis of students' preferences – but this is not always possible: however, the project abstracts are regarded as 'flexible' in the sense that significant modification is possible (subject only to mutual consent between student and supervisor). The projects involve a combination of some or all of: literature search and critique, laboratory work, theoretical work, computational physics and data reduction/analysis. The majority of the projects are *directly* related to the research conducted in the department and are undertaken within the various SPS research teams. Some students' work has led to publication in scientific journals.

Learning & teaching methods
Seminars (3h) – provide the opportunity to discuss and understand the nature and the requirements of a research project;
Lecture (1h) – to provide an outline of what is expected and required in the context of the project presentation;
Presentation and feedback (~5h) – to provide the opportunity to present the project work, and subsequently to replay the recording of the project presentation in order to provide the opportunity for self-appraisal and the sharing of best practice;
Personal support from individual supervisors and/or their research team colleagues (~20-40h) – to provide advice on all pertinent aspects of the research being undertaken and on its presentation;
Private study – to provide the opportunity for the individual student to generate material towards the work of the project (~550-570h)

Assessment methods
Coursework 100%. Students are required both to write a formal report of the work and to present their findings as a talk, such as would be contributed to a scientific conference. The conference-style presentation is filmed, and the resulting DVD used to provide detailed feedback. The work is also subject to an oral examination. The quality of the work undertaken, the project report, the oral examination and the talk will all contribute towards the final mark with approximate weightings of 30% : 40% : 20% : 10% respectively.

Core texts
None; appropriate background reading will be suggested by individual project supervisors.

ELEMENTARY PARTICLES **PH702**

School of Physical Sciences Convenor Dr. M.J. Burchell ECTS Credits 7.5
Taught in Spring term Kent Credits 15 Level M

Prerequisites: PH502, PH503, PH504 **Co-requisites:** None

Aims:

1) To present a survey of the current understanding of the fundamental constituents of matter.
1. To outline the Standard Model of quarks, leptons and gauge fields, including electroweak unified theory; and to provide some pointers beyond this model.
2. To describe basic methods used in particle physics experiments

Learning Outcomes (Subject specific):

Students should (4) be familiar with: how a particle physics experiment works, (5) have a basic knowledge of a wide range of phenomena and (6) be able to begin discussing particle physics in the language of particles and fields.

Learning Outcomes (Generic):

(7) Ability to identify relevant principles, make relevant mathematical descriptions or approximations and solve problems using a mathematical approach.

Teaching Provision: 36 contact hours: 30 lectures, 4 workshops, 2 class tests. In addition 114 hours of self study are required. The lectures will introduce students to the material and guide them through it (aims 1 $\rightarrow$ 3), self study, homework and the workshops will provide deeper understanding and comprehension (outcomes 4 $\rightarrow$ 7).

SYLLABUS:

Elementary particle theory [23 lectures and 3 workshops]

Feynman diagrams: particle exchange, units & dimensions, fundamental interactions, leptons, hadrons & quarks, strange particles, charm, truth & beauty.

Symmetries: Invariance and conservation laws, momentum, energy and angular momentum, parity.

Hadron flavours: Isospin, strangeness, quark model, resonances, quark diagrams & exotics, charmonium, the lightest hadrons, colour, confinement

QCD, jets and gluons QCD, electron-positron annihilation, elastic & inelastic electron-proton scattering, the quark-parton model.

Weak interactions: P, C and C P Parity violation, two-component neutrino theory, CP conservation, kaon decay, CP violation, conversion & regeneration of kaons.

Weak interactions: W and Z bosons Discovery of W and Z, charged current reactions, neutral currents and electroweak unified theory, number of neutrinos

Open questions Neutrino masses and mixing, the solar neutrino problem, neutrinos in cosmology, Higgs boson, grand unification, proton decay**.**

Experimental Methods [7 lectures & 1 workshop]

Accelerators, fixed target and colliders, particle interactions with matter, detectors (charged tracking, calorimeters and particle identification). The Large Hadron Collider.

Class Tests [2, each 1 hour]. Each test will cover approx. ½ the syllabus

Assessment Methods: Examination 70%, Homework 10%, 1st class test 10%, 2nd class test 10%. The exams are to test overall breadth and depth of knowledge and understanding, homework and class test are to encourage learning and comprehension during the course. The assessment will test all learning outcomes (specific and generic).

Recommended Texts:

Nuclear and Particle Physics by B.R. Martin. Pub. Wiley, 2006. ISBN 0 -470-02532-8.

Background reading:

Martin & Shaw, Particle Physics, Wiley, 2nd edition 1997 [QC213.2]
Perkins, Introduction to High Energy Physics, CUP, 4th ed. [QC173].
R.N. Cahn & G. Goldhaber, *The Experimental Foundations of Particle Physics,* 1989 (QC 793.2)
W.E. Burcham & M. Jobes, *Nuclear and Particle Physics*, 1995 (QC 196)

QUANTUM MECHANICS **PH704**

School of Physical Sciences Convenor Prof P Strange ECTS Credits 7.5
Taught in Autumn term Kent Credits 15 Level M

Teaching provision: 30 lectures, 4 workshops, 2 tests

Prerequisites: PH502

Objectives:
To outline the mathematical language of quantum mechanics and to describe a number of fundamental topics in this language.

Subject specific Learning outcomes:
An understanding of the formalism of quantum mechanics and an ability to cast physical problems into it. An acquaintance with some of the problems of quantum theory and the light shed on these by the Bell inequalities.

Generic Learning outcomes:
1. An improved ability to use mathematical techniques to model physical behaviour.
2. An improved ability to present and interpret information graphically.
3. An improved ability to use appropriate texts, or other learning resources to managing their own learning.
4. An improved problem solving ability using physical laws and mathematics
5. Transferable skills - problem solving and analytical.
6. an improved ability to manipulate precise and complex ideas and construct logical arguments.

SYLLABUS:

Introduction [3 lectures]
The two-slit experiment. The Stern-Gerlach experiment.

Mathematical formalism [14 lectures]
Bra and ket vectors, operators, completeness relation, projection operators, matrix representations; illustration on spin ½ system. Measurement, compatible and incompatible observables, uncertainty relation. Position, momentum and translation in space, wave functions, Gaussian wave packet.

Dynamics [5 lectures]
Time evolution operator, Schrödinger equation, expectation values, spin precession. Neutron diffraction in a gravitational field, Bohm-Aharonov effect, magnetic monopoles.

Angular momentum in quantum mechanics [4 lectures]
The rotation group, spin ½ representation, angular momentum eigenstates, addition of angular momenta.

Other topics [4 lectures]
Einstein-Podolsky-Rosen paradox, Einstein locality principle, Bell inequalities, Aspect experiment..

Assessment method: examination 70%, coursework 10%, tests 20%.

Recommended text
J.J. Sakurai, *Modern Quantum Mechanics* (revised edition), Addison-Wesley 1994

[Note: changes may occur to the above syllabus during the academic year 2007-2008]

SPACE ASTRONOMY AND SOLAR SYSTEM SCIENCE **PH709**

School of Physical Sciences Convenor Dr M J Burchell ECTS Credits 7.5
Taught in Autumn term Kent Credits 15 Level M

Prerequisites:

Aims:

1. To consider how astronomy can be carried out from Earth Orbit and how the Solar System can be explored by spacecraft, and some of the main results of both.
2. To develop an understanding of the evolution and composition of both our Solar System and Solar Systems in general.
3. To consider evidence for other Solar Systems.

Learning Outcomes (subject specific):

4. Students should become fluent in current trends and methods as regards space astronomy and Solar System exploration.
5. They should be able to discuss coherently the origin and evolution of Solar Systems and be able to evaluate claims for evidence of Solar Systems other than our own.

Learning Outcomes (generic):

6. Ability to identify relevant principles, make relevant approximations and solve problems using a mathematical approach.

Teaching Provision: 36 contact hours: 30 lectures, 4 workshops, 2 class tests. In addition 114 hours of self study are required. The lectures will introduce students to the material and guide them through it (aims 1 → 3), self study, homework and the workshops will provide deeper understanding and comprehension (outcomes 4 → 5).

SYLLABUS:

Space Astronomy [5 lectures + 1 workshop]
How to get above the atmosphere (sounding rockets, balloons, satellites). What wavelengths benefit by being in space. Measurements astronomers make in space using uv, x-ray and infra-red, and examples of some recent scientific missions.
Exploration of the Solar System [7 lectures + 1 workshop]
Mission types from flybys to sample returns: scientific aims and instrumentation: how to study planetary atmospheres and surfaces: properties of and how to explore minor bodies (e.g. asteroids and comets) : current and future missions : mission case study.
Solar System Evolution [5 lectures + 1 workshop]
The composition of the Sun and planets will be placed in the context of the current understanding of the evolution of the Solar System.
Extra Solar Planets [7 lectures + 1 workshop]
The evidence for extra Solar planets will be presented and reviewed. The implications for the development and evolution of Solar Systems will be discussed.
Life in Space [6 lectures]
Introduction to the issue of what life is, where it may exist in the Solar System and how to look for it

Assessment Methods: Examination 70%, Homework 10%, 1st class test 10%, 2nd class test 10%. The exams are to test overall breadth and depth of knowledge and understanding, homework and class test are to encourage learning and comprehension during the course. The assessment will test all learning outcomes (specific and generic).

Recommended Texts: There is no single set text, several background reading books are listed below:

Davies; Astronomy from Space: The Design and Operation of Orbiting Observatories, Wiley, [QB136]
Encrenaz, Bibring and Blanc; The Solar System, Springer, [QB 501]
Clark; Extra-Solar Planets, Wiley [QB 820]
Jakosky: The Search for Life on Other Planets [QB 54]
Gilmour & Sephton: Introduction to Astrobiology [qQB 501]

[Note: Changes may occur to the syllabus during the year**]**

ADVANCED COSMOLOGY AND THE INTERSTELLAR MEDIUM PH712

School of Physical Sciences Convenor Dr D Froebrich ECTS Credits 7.5
Taught in Spring term Kent Credits 15 Level M

Prerequisites: PH507, PH607

Aims: To provide in-depth study of selected astrophysics material to allow a student to proceed to entry to a research degree in the field of astronomy and astrophysics.

Subject Specific Learning Outcomes: To have gained an appreciation of current knowledge in the fields of extragalactic astrophysics and the interstellar medium.

Generic Learning Outcomes: Ability to make literature reviews in an academic discipline.

SYLLABUS:

Interstellar Medium (12 tutorials)
The major properties of the Interstellar Medium (ISM) are described. The course will discuss the characteristics of the gaseous and dust components of the ISM, including their distributions throughout the Galaxy, physical and chemical properties, and their influence the star formation process. The excitation of this interstellar material will be examined for the various physical processes which occur in the ISM, including radiative, collisional and shock excitation. The way in which the interstellar material can collapse under the effects of self-gravity to form stars, and their subsequent interaction with the remaining material will be examined. Finally the end stages of stellar evolution will be studied to understand how planetary nebulae and supernova remnants interact with the surrounding ISM.

Extragalactic astrophysics (10 tutorials)
The course will review the FRW metric, source counts, the cosmological distance ladder and standard candles/rods in order to establish the structure of the Universe. Probes into the high-z regime (the fundamental plane, the Tully-Fisher relation, low surface brightness galaxies, luminosity functions and high-z evolution and the Cosmic Star Formation History) are addressed. Further topics include: Galaxy clusters, the Butcher-Oemler effect, the morphology-density relation, the SZ effect; AGN and black holes, Beaming and superluminal motion; Unified schemes, Black hole demographics, high-z galaxy and quasar absorption and emission lines, gravitational lensing [if time].

Learning and Teaching Methods: 22 one-hour tutorial workshops, two class tests, and directed reading. Directed reading addresses generic learning outcome; tutorial material and directed reading addresses subject specific learning outcomes.

Assessment Methods: Examination 70%; Coursework 10%; Class tests 20%

Suggested Reading:

- Dyson & Williams, The Physics of the Interstellar Medium, IOP Publishing ISBN 0 7503 0460 X [QB790.D97 1997]
- Peacock, Cosmological Physics, CUP, ISBN 0 521 42270 1 [QB 981]
- Rowan-Robinson, Cosmology, OUP, ISBN 0198518587 [QB 981]
- Bowers & Deeming Astrophysics vol. 2 ISBN 0867200189 [QB 461]
- Carroll, Press & Turner, 1992, Annual Reviews of Astronomy and Astrophysics, 30, 499-542

[Note: Minor changes to the syllabus may occur during the year]

MATHEMATICS II **MA588**

IMS Convenor Dr TC Dunning (Mathematics), Dr G Dobre (Physics) ECTS Credits 7.5 Kent
Taught in Autumn Term Kent Credits 15 Level I

Teaching Provision: 34 lectures, 2 class tests, 6 workshops and 6 console sessions.

Prerequisites: PH300.

Aims:

1 To provide a working knowledge, for physical applications, of advanced mathematical methods.
2. An appreciation of the domain of application of these methods.

Learning Outcomes:

1. An understanding of the techniques required to solve advanced physical problems.
2. Ability to solve problems in mathematical physics under a wide range of conditions.
3. The applications and properties of linear mathematics in physical problems.

SYLLABUS:

Fourier Series and Transforms [11 lectures]
Fourier series, sines and cosines as a complete set of functions, determination of expansion coefficients, Parseval's theorem. Expansion of a periodic function in trigonometric and complex exponential variables, determination of coefficients. Definition of Fourier transform and study of its properties and applications, convolution and correlation.

Partial Differential Equations (PDEs) [6 lectures]
Solution of PDEs of Physics, separation of variables, boundary conditions, eigenfunctions, Fourier series solutions.

Ordinary differential equations [6 lectures]
Series solution to differential equations, method of Frobenius. Application to Legendre's equation and polynomial solutions, Bessel's equation, etc. Method of reduction in order.

Orthogonal Polynomials and Functions [12 lectures]
Defining property: inner products for functions. Generating functions, recurrence relations and Rodrigues formula for Legendre and Hermite polynomials; other examples (e.g. Chebyshev, Laguerre) where appropriate.

Assessment Methods: Examination 70%; Coursework 30%.

Recommended Texts:

E Kreyszig. *Advanced Engineering Mathematics.* (8th ed., Wiley, 2005) (E)
Boas, Mathematical Methods in the Physical Sciences, Wiley, 1993 [QA300] or 3rd edition 2005

SECTION C: TEACHING AND EXAMINATION PROCEDURES

C1. LECTURES AND COURSEWORK

ATTENDANCE AND DILIGENCE

Much of the basic material is covered in lectures and you will find it very difficult to make a success of a science degree programme unless you attend all lectures. Consequently, ***attendance at lectures in Physical Sciences modules is compulsory.***

Attendance at laboratory and other practical classes, workshops, seminars and examples classes is ***compulsory***. Most modules have an element of continuous assessment, which may take the form of problem sheets, essays, class tests, laboratory write-ups or oral contributions. All written course work and examination answers must be clearly legible and submitted in clear, standard English. Work which does not conform to such standards may not be marked. Marking criteria for coursework such as dissertations, project reports and essays will be published during the year.

Marks

Continual assessment marks are recorded on the University's Course Management & Student Data System (CMSDS). You may access your own records to check progress during the year.
If you believe that you have been awarded the wrong mark for a piece of assessment (ie you have the original returned work which shows a different mark to that on the system) you should collect a Change of Mark Form from the student administration office or download from the PASS pages of the department's website and take it to the person who marked your work. If appropriate, they will complete the form authorising student administration to amend the mark on the system. No marks will be amended without authorisation from the member of staff responsible for the assessment in question.

DEADLINES AND EXTENSIONS

The deadlines for submission of written work will be clearly defined. Work submitted after the deadline will not normally be marked and will be returned to the student with a mark of zero. If you are unable to submit coursework by the published deadlines due to reasons of sickness or personal circumstances then, in order for any allowances to be made, you must adhere to the following procedures:

Short Term Absence

If you have missed lectures, labs, workshops or examples classes due to a short term illness (less than 5 days), or for any other reason, you should complete an Undergraduate Absence Form within 2 weeks of your return to study and return it to the student administration office. Forms are available from the student administration office (room 209) or on the Web at
http://www.kent.ac.uk/physical-sciences/main/undergraduate/pass/index.htm
and will need to be signed off by your tutor.

Longer Term Absence

All longer term illnesses (more than 5 days) and absences should be reported to your tutor as soon as it practicable, so that he/she can help you to manage your studies and advise you on the best course of action for your individual circumstances.
You will be asked to provide a medical certificate or other means of verifying the reason for your absence, and should complete an Undergraduate Absence Form, within 2 weeks of your return to study, to accompany your documentation, and return it to the student administration office. Forms are available from the student administration office (room 209) or on the Web at
http://www.kent.ac.uk/physical-sciences/main/undergraduate/pass/index.htm.

Illnesses and difficult or distressing events are a normal part of life. Students are expected to manage these and continue with work or study. Such difficulties are not normally accepted in mitigation for failure to submit coursework, to attend an examination or for impaired performances in coursework or examination.

Concessionary evidence submitted during the course of the academic year will either be discharged by the disregarding of specific marks on specific modules at the time of the concession only when authorised by your tutor, or considered by the Concessions Panel and then the Board of Examiners (which is empowered to condone failed modules and adjust degree classifications, depending on the nature and seriousness of the concession). It is important to note that your tutor's ability to recommend disregarding items of coursework is strictly limited, and will be used accordingly.

All concessionary evidence submitted to your tutor, or in certain special cases the Senior Tutor, is treated as confidential and will be handled accordingly.

MONITORING OF PROGRESS

The progress of students is continually monitored via coursework submission (and examination) and a failure to fulfil your obligations regarding attendance and diligence can result in a student being required to withdraw from the University (section 5.2 of the Regulations for Taught Programmes of Study). Students so required have the right to make representation to the Faculty Review Panel before a decision on such a recommendation is confirmed. Requests for a review should be submitted in writing to the Faculty Officer. Such a request should outline the grounds for a review.

COMPLAINTS PROCEDURE

As a student you are entitled to receive competent teaching on all courses you take. If you, as an individual or as one of a group of students, feel that the basic requirements of good teaching are not being met, or that there are other issues to do with a module or its teacher(s) which you feel give grounds for complaint, you should raise the matter immediately. In many cases you will be able to sort out any problems on the spot by talking them through with the teacher(s) of the module. The Convenor of a module is the person who will normally consider any complaints not resolved in this way. Another possible route is to talk to your tutor. In the event that this process fails to generate a satisfactory solution, and especially in cases where the issue affects several students in your peer group, you should ask your elected year-group representatives to take the matter to the Staff Student Liaison Committee to be aired more widely. The Director of Undergraduate Studies and/or the Head of Department may become involved in order to help resolve unusually intractable issues. The key fact is that, as a department, we are committed to taking all constructive input seriously and to taking remedial action where this is found to be necessary.
Student feedback questionnaires, which are distributed at the end of each section of a module, enable your teachers to pick up suggestions for future improvement. The results from the questionnaires are discussed at the Teaching Committee module review meetings, where student representatives are present. If you wish at the end of a module/academic year to make a case that the inadequacies of the teaching have affected your overall performance, it is important that you raised any complaint you may have had about that module, or about an associated teacher, immediately it became a matter of concern to you.

The School's Personal and Academic Support System also has a grievance procedure, for students who may feel it necessary to request that they are allocated a different tutor. This can be found online at:
http://www.kent.ac.uk/physical-sciences/main/undergraduate/pass/index.htm

C2. EXAMINATIONS

REGISTRATION FOR EXAMINATIONS

All students are required to confirm that they have been correctly entered for end of year examinations. Notices about the arrangements for this will be posted throughout the campus towards the end of the Autumn Term and you will be required to register for your examinations online early in the Spring Term..

USE OF CALCULATORS

Students are required to use calculators in their studies. However there are restrictions in examinations to prevent students from having access to information which might give them an unfair advantage. The present rules about calculators in examinations are that students will be allowed to use noiseless, non-mains, single-line display, non-programmable calculators without ascii memories in examinations. This definition means that the use of graphical calculators is prohibited.

STAGE 2, STAGE 3, STAGE 4 EXAMINATIONS

Students are required to successfully complete Stage 2 before being allowed to proceed to Stage 3. Students doing a 4-year degree must successfully complete Stage 3 before being allowed to proceed to Stage 4.
Each module is assessed separately with the contribution of written examination and continuous assessment explained in the module outlines (Section B). Written examinations take place in the Summer Term. If you fail

the examination you may be offered the opportunity to re-sit in August of the same year. You should note that in such circumstances it is rarely possible to repeat course work and any continuous assessment marks will be carried forward to the re-sit examination. Laboratory and project work cannot be repeated during the summer. Students are allowed a maximum of two re-sits, but may be offered the chance to repeat individual modules, or the whole year.
Modules which are assessed by 100% coursework (CH620, PS602, PS620, PS700, PH307, PH500, PH512, PH520, PH600, PH603, PH616, PH617) are designed so that you acquire skills through successful completion of assignments during the year. There is no end-of-year written examination.

PASS MARK FOR STAGES 2, 3 &4

To pass the examinations at Stages 2, 3 & 4, candidates must be awarded credit in all modules under the Credit Framework (see below). For MPhys students there is a requirement to achieve a 55% overall average mark in the 2nd year in order to continue to the 3rd year of the course. Students who do not achieve a 55% average will be required to change their registration to the corresponding BSc course.

MPhys programmes based in Kent:
Kent based MPhys students who fail to achieve 55% at the first attempt may progress to Stage 3 of the relevant MPhys programme if they achieve the required average on resit of failed modules.

MPhys with a Year in the USA programmes:
MPhys with a year in the USA students must obtain 55% at the first attempt in order to be able to take up the placement, on administrative grounds.
MPhys with a year in the USA students who fail to obtain 55% at the first attempt but subsequently achieve it on resit of failed modules will be permitted to transfer to the relevant Kent based MPhys programme.

The threshold for progression from the 3rd to the 4th year of a MPhys degree is the achievement of a 50% average mark across the modules taken in the 3rd year. Students who do not achieve this mark at the first attempt, or on resit of failed modules will be required to transfer to the BSc degree, which would therefore be awarded at the end of their third year. Their marks will be treated as other students taking the BSc degree.

Please note, trailing modules within any of the MPhys programmes will not be permitted. At Stage 2 of the MPhys programmes, credit will not be awarded for modules by compensation or condonement.

CREDIT FRAMEWORK

The University uses a 'credit framework' for all of its taught programmes of study, similar to the credit systems adopted by many other universities in the UK. This is intended to make it easier for students to obtain exemption from part of a University of Kent programme on the basis of study elsewhere and similarly for students to transfer credit obtained at this University to another university or college.

This section of the Handbook aims to explain those aspects of the credit framework, which will be of interest to students. However, it should be regarded as an informal guide only. The full Credit Framework Regulations may be found on the University web site at http://www.kent.ac.uk/registry/quality/credit/index.html

Outline of the Credit Framework

In order to be eligible for the award of a certificate, diploma or degree by the University, you must take an approved programme of study, obtain a specified number of credits, the number required depending on the award in question, and meet such other requirements as may be specified for the programme of study in question. Each programme of study comprises a number of modules, usually at different levels and each worth a specified number of credits.

Programme specifications for each SPS degree course may be found on the University web site at:
http://www.kent.ac.uk/stms/staff-student/prog-specs.html

In order to be awarded the credits for a module, you must normally demonstrate, via assessment, that you have achieved the learning outcomes specified for the module. Limited credit may also be awarded where assessment has been affected by illness (condonement) or where you have demonstrated in other modules that all programme learning outcomes have been achieved (compensation).

Most programmes of study are divided into stages, usually equivalent to one year of full time study. You must satisfy prescribed requirements for each stage of a programme before being permitted to proceed to the next stage.

Many programmes of study lead to 'classified' awards. For example, undergraduate Honours degrees are awarded with First Class, Upper Second Class, Lower Second Class or Third Class Honours and Certificates may be awarded with Merit or with Distinction.

Example: a student taking a three year full time undergraduate honours degree programme is required to obtain a total of 360 credits of which at least 90 must be at level 'H' or above (Stage 3 modules are normally at level 'H') and at, most, 150 may be at level 'C' (Stage 1 modules are normally at level 'C'). Many three-year full time honours degree programmes comprise 120 level C credits in Stage 1, 120 level I/H credits in Stage 2 and 120 level H credits in Stage 3. At least 90 credits must be obtained in Stage 1 before progression to Stage 2 is permitted and at least 90 credits must be obtained in Stage 2 before progression to Stage 3 is permitted.

Programmes of Study
Each programme of study comprises an approved set or sets of **modules** and is divided into a number of **stages**. Each module is at a specified **level** and successful completion of the module results in the award of a specified number of **credits at that level**. The University defines these terms as follows:

Credits: one credit corresponds to approximately ten hours of 'learning time' (ie including all taught or supervised classes and all private study and research). Thus obtaining 120 credits in an academic year of 30 weeks requires approximately 1,200 hours of learning time, equivalent to approximately 40 hours per week.

Module: a module is a self contained component of a programme or programmes of study with defined learning outcomes, teaching and learning methods and assessment requirements. Each module normally corresponds to a multiple of 15 credits ie to 15, 30, 45… credits though the Faculty may approve exceptions where it is satisfied that there is good reason to do so.

Level: each module is at one of the following levels:

F	Foundation
C	Certificate
I	Intermediate
H	Honours
M	Masters

The level descriptors adopted by the University for these levels may be found in Annex 2 of the Credit Framework Regulations.

Stage: Most programmes of study are divided into a number of stages and you must achieve specified requirements in each stage except the final stage before being permitted to progress to the next stage. For undergraduate honours degree programmes, a stage will normally consist of modules amounting to 120 credits.

Awards: In order to be eligible for the award of a certificate, diploma or degree by the University, you must obtain at least the minimum number of credits specified for that award at the specified levels. These requirements are set out in Annex 4 of the Credit Framework Regulations. Individual programmes or groups of programmes will normally specify additional requirements which must be met for the award of the qualification in the subject concerned, for example by requiring specified modules to be taken and passed.

Award of Credits

Successful Completion of Module
If you successfully demonstrate via assessment that you have achieved the specified learning outcomes for a module you will be awarded the number and level of credits prescribed for the module. Assessment methods vary between modules and assessment is designed so that achievement of the pass mark or above will demonstrate achievement of learning outcomes. Module specifications will state whether the pass mark has to be achieved overall and/or in prescribed elements of assessment. The pass mark is 40%.

Condonement
If you fail a module or modules due to illness or other mitigating circumstances, the Board of Examiners may condone the failure and award credits for the module(s), up to a limit of 25% of each stage of a programme of

study, provided that there is evidence to show that you have achieved the **programme** learning outcomes and provided that you have submitted written medical or other evidence to substantiate any claim of illness or other mitigating circumstances. The marks achieved for such modules will not be adjusted to take account of the mitigating circumstances, but transcripts will indicate modules for which credits have been awarded via condonement and the marks will not be used in the calculation of overall grades. Each programme rubric specifies the modules in which failure cannot be condoned.

Compensation

If you fail a module or modules but your marks for such modules are within 10 percentage points of the pass mark (ie 30% or above), the Board of Examiners may nevertheless award you the credits for the module(s), up to a limit of 25% of each stage of a programme of study, provided that your average mark for the stage is 40% or above and provided that there is evidence to show that **programme** learning outcomes have been achieved. The marks achieved for such modules will be adjusted to the minimum pass mark and transcripts will indicate modules for which credits have been awarded via compensation. Each programme rubric specifies modules in which failure cannot be compensated.

Progression

When you have completed a stage of a programme of study other than the final stage, the appropriate Board of Examiners will decide whether you may progress to the next stage of the programme of study, or to another programme of study.

The normal requirement for progression from one stage of a programme of study to the next is that you should have obtained at least 75% of the credits for the stage and should have obtained credits for those modules which the programme specification indicates must be obtained before progression is permitted.

Referral

If you are not permitted to progress to the next stage of a programme, or if, on completion of the programme, you fail to meet the requirements for that award, the Board of Examiners may permit you to undertake further assessment in failed modules. The Board of Examiners will specify which elements of assessment you are required to undertake.

If you are so referred in a module you may be required to, or may elect to, **repeat** the module, before progressing to the next stage of the programme, provided that it is being taught in the year in question, or you may choose to take a different module provided that the requirements of the programme of study are still met, but must do so before progressing to the next stage of the programme. At most two such opportunities per module will be permitted, the first of these to be automatically permitted unless denied for disciplinary reasons and normally available during the long vacation following the initial failure.

Trailing and Retrieving Credit

If you are permitted to progress to the next stage of a programme but have not been awarded full credit for the previous stage, you will still need to obtain credits for modules for which you have so far not been awarded credit in order to meet requirements for the award of the certificate, diploma or degree for which you are registered. You will be permitted to 'retrieve' such credits, up to a maximum of 25% of the credits for the stage, in one of two ways as follows:

By undertaking further assessment, for example a re-sit examination, before the start of the next academic year. If you are permitted to retrieve credit in this way you may elect to **repeat** the module, provided that it is being taught in the year in question, or you may choose to take a different module, provided that the requirements of the programme of study are still met.

By progressing to the next stage of the programme and simultaneously undertaking such further requirements as the Board of Examiners specifies in relation to the failed modules. This is known as **trailing** credit. Where credit is trailed, the Board of Examiners may permit the you to repeat the failed module(s) provided it/they are available and the timetable permits or to take alternative module(s) as permitted by the programme specification or may specify assessment to be undertaken satisfactorily for the award of the credits in question. If you trail credit in this way and again fail to obtain the credits, the credit may **not** be trailed to the next stage of the programme eg you will not be permitted to progress to Stage 3 of a programme unless you have obtained **all** Stage 1 credits and met the minimum progression requirements in Stage 2.

In an intellectually progressive science degree, each year's study builds on the previous year and requires successful completion of all of the previous year's study as a pre-requisite. For this reason, the Boards of Examiners will NOT permit the trailing of modules in any Forensic Science or Physics degree programmes except at their discretion in exceptional circumstances.

Application of the Condonement, Compensation and Trailing Provisions
The application of condonement, compensation or trailing provisions is limited to a maximum cumulative total of 25% of the credit for any stage.

The provisions for the condonement or compensation of failure or for the trailing and retrieving of credit will be applied only if you have failed modules amounting to 25% or less of the credit for the stage.

Deferral
If you have been unable to complete assessment requirements or your performance has been affected by circumstances such as illness, and where there is written evidence to support this, the Board of Examiners may permit you to undertake some or all of the assessment for some or all of the modules comprising the stage at a later date and as for the first time. If you have met requirements for progression to the next stage of the programme, you may be permitted to 'trail' the deferred assessment ie to proceed to the next stage and simultaneously undertake the deferred assessment as for the first time

EXAMINATION WEIGHTINGS

Forensic Science, Forensic Chemistry and Physics with Forensic Science

Three year BSc degrees:

Stage 2 examinations + continuous assessment marks	40%
Stage 3 examinations + continuous assessment marks	60%

Four year BSc degrees with a year in industry

Stage 2 examinations + continuous assessment marks	32%
Assessment from Stage P	20%
Stage 4 examinations + continuous assessment marks	48%

Physics

Three Year Degrees:

Stage 2 examinations + continuous assessment marks	40%
Stage 3 examinations + continuous assessment marks	60%

Four Year MPhys Degrees with a year abroad:

Stage 2 examinations + continuous assessment marks	32%
Assessment from Stage P	20%
Final year examinations + continuous assessment marks	48%

Four Year MPhys spent entirely at Kent

Stage 2 examinations + continuous assessment marks	25%
Stage 3 examinations + continuous assessment marks	37.5%
Stage 4 examinations + continuous assessment marks	37.5%

*S/P = Sandwich/Placement

AWARD AND CLASSIFICATION OF QUALIFICATIONS
Certificates and diplomas may be awarded 'with Merit' and 'with Distinction' and Honours degrees are awarded with First, Upper Second, Lower Second or Third class Honours. Full details of the requirements for these awards may be found in the Credit Framework Regulations at http://www.kent.ac.uk/registry-local/quality/credit/.

STMS has agreed on the 'average' method of classification.

Degree Classification
A candidate who has met the requirements of the Credit Framework for the award of an Honours Degree will be placed in an Honours Class. The classification of degrees is based on a weighted average of the marks obtained over all modules in Stage 2 and above of the programme of study. The degree class is determined as follows:

Weighted average mark (%)	Class
70 and above	First Class Honours
60 – 69.9	Upper Second Class Honours (2.i)
50 – 59.9	Lower Second Class Honours (2.ii)
Below 50	Third Class Honours

Note: Although credits are normally awarded for a mark of 40% or above in a module, a student might obtain the credits required for award of an Honours degree but have an average mark of less than 40% where some credits have been obtained via compensation and/or condonement.

The Board of Examiners may recommend, in exceptional circumstances, that a candidate be awarded a class of degree higher than that which would be derived from the application of the conventions set out above.

Diploma Classification
To be awarded the Diploma students must achieve 120 credits at least 90 of which are at level I or above. The classification of 1 year Diplomas is based on a weighted average of the marks gained during the year of study as follows:

Weighted Average Mark (%)	Classification
70 and above	Distinction
60-69.9	Merit
Below 60	Pass

Viva-voce Examinations
Degree and Diploma candidates may be required to attend a viva-voce (oral) examination with an External Examiner, immediately prior to the Examiners' Meeting at which the classification of the results is decided. Since it will not be known in advance which candidates will be given such an examination, all Finals students, including candidates for the Diplomas and MPhys year 3 candidates are required to be available for examination on the Examination Day(s), which will be specified in advance.

Fallback Awards
A student who successfully completes one or more stages of an Honours degree programme but does not successfully complete the whole programme will be eligible for a "fallback award" i.e. for award of a Certificate, Diploma or non-Honours degree as appropriate. The requirements of the credit framework to satisfy the learning outcomes of the fallback award must be fulfilled. See the programme specifications

CONCESSIONARY EVIDENCE AND THE RIGHT TO APPEAL

If you are ill during examinations or there are other serious circumstances impairing your examination performance, you may make written representations for the consideration of the Board of Examiners. Such representations must be made within one week of the examination concerned and submitted to the Departmental Administrator and the Senior Tutor. Personal and other problems can also be considered if a case is received in writing.

There is no appeal against the academic judgement of the Examiners, but students may be able to appeal in certain circumstances. The student should discuss this with the Director of Undergraduate Studies in the first instance.

Details of appeals procedures may be found at:
http://www.kent.ac.uk/registry/quality/credit/creditinfoannex9.html.

RETENTION OF COURSEWORK

Examiners may ask to see coursework at the end of your second year, third or final year. Students should therefore retain all written work, including laboratory reports and any project reports that have been returned to them. Compulsory written work submitted for workshops or examples classes should also be retained and may be taken into consideration by the Examiners. Students who are required to submit their coursework will be notified by the Chief Examiner concerned during the latter part of the Summer Term.

CHEATING IN THE EXAMINATIONS

The University's "General Regulations for Students" are issued to every student on admission to the University. They are also published at:

www.kent.ac.uk/regulations/

Regulation III.4(ii) of the General Regulations for Students states that 'Except where allowed by the examination instructions, no candidate may introduce into the examination room any book, manuscript or other object or material relevant to the subject of the examination'.

Regulation III.4(v) states: 'Any candidate suspected of using or attempting to use any unfair means, including copying, or attempting to copy from the work of another candidate in the examination room, will be reported immediately by the Invigilator to the Secretary and Registrar. Such a person will render himself liable to disciplinary action, which may include failure in the whole or in part of the examination'.

The University regards cheating or attempting to cheat as an extremely serious offence. Students who are found to have cheated may fail the examination overall.

PLAGIARISM AND DUPLICATION OF MATERIAL

ACADEMIC INTEGRITY AND HONESTY AT UNIVERSITY.

What is academic integrity?

While you are at university, you are expected and required to act honestly regarding the work you submit for assessment in your courses. General Regulation V.3: Academic Discipline states that:

> **Students are required to act with honesty and integrity in fulfilling requirements in relation to assessment of their academic progress.**

General Regulation V.3 specifies that any attempts to:

- cheat,
- plagiarise,
- improperly influence your lecturer's view of your grades,
- copy other assignments (your own or somebody else's) or
- falsify research data

will be viewed as a breach of this regulation.

The full details of this regulation including disciplinary procedures and penalties are available at:
http://www.kent.ac.uk/registry/quality/credit/creditinfoannex10.html

Most students do not have any problems understanding the rules and expectations about acting honestly at university, although some are not familiar with academic expectations and *plagiarism*.

What is plagiarism?

General Regulation V.3 states that plagiarism includes:

> **reproducing in any work submitted for assessment or review (for example, examination answers, essays, project reports, dissertations or theses) any material derived from work authored by another without clearly acknowledging the source.**

In addition, certain departments or subjects may define plagiarism more narrowly.

The School of Physical Sciences' policy for handling plagiarism can be found at:
http://www.kent.ac.uk/physical-sciences/main/undergraduate/pass/index.htm; **please read this carefully: ignorance of the policy will not be accepted as mitigation for an offence.**

This means that if you read, study or use any other work in your assignment, you must clearly show who wrote the original work. This is called referencing and correct referencing will help you to avoid accusations of plagiarism.

What is referencing?

Referencing means acknowledging the original author/source of the material in your text and your reference list. Examples of source material which should be referenced include:

- exact words (written or spoken)

- summarised or paraphrased text
- data
- images (graph, tables, video, multimedia etc)
- pictures or illustrations
- ideas or concepts
- theories
- opinion or analysis
- music or other performance media
- computer code
- designs, drawings or plans.

A variety of referencing styles are in use at the University of Kent. Specific style guides can be accessed from your department, library or UELT website.

Good referencing and avoiding plagiarism are pre-requisites to good writing. If you are unsure about essay writing in general or want to make sure that you will receive the good marks you deserve, you can visit the Student Learning Advisory Service based in the UELT building. For details see: http://www.kent.ac.uk/uelt/learning/index.html

EUROPEAN CREDIT TRANSFER SYSTEM

The University has adopted the European Credit Transfer System (ECTS) in the context of our participation in the Erasmus programme and other European connections and activities.

What is ECTS?
ECTS, the European Credit Transfer System, was developed by the Commission of the European Communities in order to provide common procedures to guarantee academic recognition of studies abroad. It provides a way of measuring and comparing learning achievements, and transferring them from one institution to another.

ECTS credits
ECTS credits are a value allocated to module units to describe the **student workload** required to complete them. They reflect the **quantity** of work each module requires **in relation to** the total quantity of work required to complete a full year of academic study at the institution, that is, lectures, practical work, seminars, private work - in the library or at home - and examinations or other assessment activities. ECTS credits express a **relative value**.

In ECTS, 60 credits represent the workload of a year of study; normally 30 credits are given for a semester and 20 credits for a term. It is important that no special courses are set up for ECTS purposes, but that all ECTS courses are mainstream courses of the participating institutions, as followed by home students under normal regulations.

It is up to the participating institutions to subdivide the credits for the different courses. Practical placements and optional courses which form an integral part of the course of study also receive academic credit. Practical placements and optional courses which do not form an integral part of the course of study do not receive academic credit. Non-credit courses may, however, be mentioned in the transcript of records.

Credits are awarded only when the course has been completed and all required examinations have been successfully taken.

ECTS students
The students participating in ECTS will receive full credit for all academic work successfully carried out at an ECTS partner institutions and they will be able to transfer these academic credits from one participating institution to another on the basis of **prior agreement** on the content of study programmes abroad between students and the institutions involved.

The ECTS Grading Scale
Examination and assessment results are usually expressed in grades. However, many different grading systems co-exist in Europe. Interpretation of grades varies considerably from one country to another, if not from one institution to another.

The ECTS grading scale has thus been developed in order to help institutions translate the grades awarded by host institutions to ECTS students. It provides information on the student's performance additional to that provided by the institution's grade; it **does not replace the local grade**. Higher education institutions make their own decisions on how to apply the ECTS grading scale to their own system.

1. Each institution awards marks/grades on the basis of its normal procedures and system and these marks form part of the student transcript.
2. The ECTS scale is designed as a "facilitating scale" to improve transparency but not to interfere with the normal process of awarding marks within each institution or attempt to impose uniformity. The ECTS grading scale ranks the students on a statistical basis.
3. Within the broad parameters set out below each institution makes its own decision on the precise application of the scale.

ECTS GRADING SYSTEM	
ECTS Grade	**% of successful students normally achieving the grade**
A	10
B	25
C	30
D	25
E	10
FX	A distinction is made between the grades FX and F that are used for unsuccessful students. FX means: "fail- some more work required to pass" and F means: "fail – considerable further work required".
F	

DIPLOMA SUPPLEMENT

What is the Diploma Supplement?

The Diploma Supplement was developed to provide students with a document that will be attached to a higher education qualification and improve international recognition of academic and professional qualifications (diplomas, degrees, certificates etc).

The supplement provides a description of the nature, level, context, content and status of the studies a student pursued and successfully completed. All graduating students of the University of Kent receive a Diploma Supplement.

Why is the Diploma Supplement required?

Countries are constantly updating their qualification systems to encompass new qualifications that arise as a result of technological, political and economic changes. With people now taking greater advantage of work and study opportunities abroad, the need for a means of providing recognition of qualifications has become essential. As a result, further information about the level and function of a qualification is required to provide transparency.

The Diploma supplement aims to meet these demands by:

§ Promoting transparency within Higher Education
§ Taking into account changes in qualifications
§ Aiding mobility and access to further study and employment abroad
§ Providing fair and informed information relating to qualifications

What information does the Diploma Supplement contain?

The Diploma supplement comprises eight sections.

1. **Identification of the qualification holder:** Name, date of birth, student institution identification number/code.
2. **Identification of the qualification and its originating institution:** Name of qualification, name and type of awarding institution, language(s) of instruction and examination.

3. **Information on the level of qualifications:** Level of qualification, access requirements, main fields of study for the qualification.
4. **Information on the contents and results obtained:** Mode of study, normal length of programme, programme requirements, courses/modules/units studied, individual grades obtained, ECTS grade, grading scheme and grade distribution, award classification.
5. **Function of the qualification:** Qualification title, further study opportunities (e.g. postgraduate), any professional status conferred.
6. **Additional Information:** Any additional information and further sources as relevant.
7. **Certification of the Supplement: Date and signature, official stamp or seal.**
8. **Information on the National Higher Education system of the country issuing the diploma: Overview** of the educational system and awards structure of the awarding country.

What does the Diploma Supplement offer to students?

The Diploma Supplement aims to provide students with information relating to their programme of study that is both easily understood and comparable abroad. It provides an accurate description of a student's academic curriculum and competencies acquired during the period of study that may be relevant for further study and employment opportunities abroad.

Who should I contact if I have any queries?

If you have any queries relating to the Diploma Supplement, please contact the Student Records Office

C3. TRANSFER OF DEGREE PROGRAMME AND/OR MODULES

TRANSFER OF MODULES

Any change to the modules for which a student is registered requires the approval of the convenors concerned together with the Director of Undergraduate Studies. All such applications must be made on the official module transfer form, which can be obtained from the Departmental Administration Office. Students are advised to discuss such changes with their tutor in the first instance. Module transfers will not normally be permitted after Week 3 of the Autumn Term.

TRANSFER OF DEGREE PROGRAMME (INCLUDING BETWEEN DIFFERENT SPS DEGREES)

Any transfer of degree programmes is subject to the approval of both of the Directors of Undergraduate Studies concerned. If you are transferring to a degree programme which requires a compulsory module you are not already taking you should normally make the change before the end of the third week of the Autumn Term.

The Education (Mandatory Awards) Regulations provide that a Local Education Authority can refuse to agree to the transfer of a mandatory grant (and thus, in effect, to a student changing his/her degree course) if either

(a) its consent to the change has not been given within 12 months of commencement of the award, i.e. before the beginning of the second year of study, or

(b) the new degree course is of longer duration than the course for which the student originally registered.

In the present financial climate there is increasing evidence that consent to such changes may be refused if either of the above provisions have not been met. Students are, therefore, strongly advised to ensure that any change of degree course is formally approved by the Faculty and the LEA informed by the student within the 12 month period. Students who have already completed a Foundation Year should complete any transfer of their degree registration before the start of the Autumn term in Stage 1.

Students who initially register for a 3 year B.Sc. degree and wish to change to a 4 year M.Phys. degree should inform their LEA before the start of the second year courses. Transfers may also be made at a later stage but the financial support will not normally be approved for the full 4 year programme.

Students wishing to transfer to another Faculty should consult their tutor in the first instance and then see the Director of Undergraduate Studies.
NB. If you wish to transfer degree programmes and/or modules you must fill in an official transfer form from the Departmental Administration office (room 209).

STUDENTS WISHING TO INTERMIT

It is important that you seek help if you are experiencing problems with your studies.
If you seek a period of intermission you are strongly advised to check the financial consequences with your sponsors. It is very important that your sponsor is consulted.
PLEASE NOTE THAT IF YOU HAVE NOT HAD PERMISSION TO INTERMIT, YOUR FEES WILL NOT BE ADJUSTED – AND YOU WILL BE CHARGED FULL FEES FOR ACCOMMODATION AND TUITION.
Students take time out from their degree (known as intermitting) for a variety of reasons, mainly personal, but sometimes academic or financial. If you feel you need some time out, go and see your tutor, or perhaps the University Counselling Service, if appropriate. Intermitting does not change the duration of your degree it just gives you the opportunity to take some time away from University should you need to. The University does not encourage people to take longer than normal to complete their studies but is willing to discuss this with you. Whatever is decided you will need to speak to your funding body to ensure that any funding you receive is not affected by intermission.

Intermission is normally given for a complete academic year, or occasionally part of an academic year. Your Departmental Senior Tutor will ultimately be responsible for authorising your period of intermission. However, **no intermission will be granted after the end of student examination registration, i.e. end of Friday 25January 2008.**

Possible reasons for leave to intermit are:

1. **Personal Grounds** - Family or personal reasons (other than illness) prevent you from continuing your studies

2. **Financial Grounds** - Where your financial situation prevents you from continuing your studies.
3. **Medical Grounds**:
   - (a) Absence from the University due to medical or emotional reasons, or other such extenuating circumstances.
   - (b) Illness or extenuating circumstances, which are having a negative impact on your studies.
   - (c) Illness or extenuating circumstances that have interrupted your studies

   When the reason for intermitting is medical, then your Departmental Senior Tutor will request medical evidence. They will not ask for supervision reports. Before you return from intermission, you will be required to provide another medical certificate to testify that you are fit to return to your studies.

A few things to remember:

- Intermitting does not change the number of terms you will spend at the University, or your examination results.
- Intermitting is intended to relieve you of a disadvantage, not put you at an advantage to other students.
- If you intermit within 4 weeks of the start of full term (and you are privately funded) then you will be entitled to full return of your university fees for that term and for the remainder of the academic year. If you are LEA funded then 1 December is the cut-off date.
- If you subsequently want to change the period for which you have been permitted to intermit, you must seek approval from your Departmental Senior Tutor.
- If you have to go out of residence quickly for medical reasons, make sure you are seen by a doctor at the time so they can give you a medical certificate that reflects the severity of your condition.
- Make sure that your LEA is informed if you intermit

If you wish to intermit you should discuss the matter with your tutor in the first instance. Final permission will be granted by the Department Senior Tutor where there are good medical, financial or personal reasons, or where intermission can be shown to be in your academic interests. Further details at http://www.kent.ac.uk/physical-sciences/main/undergraduate/pass/index.htm.

WITHDRAWING FROM THE UNIVERSITY

Students wishing to withdraw from the University should contact their tutors in the first instance. If you are considering withdrawing from the University, please do not just depart as this can create problems for yourself in relation to your LEA and also with regard to any future application for higher education, whereas these problems can be largely avoided if you go through the proper channels. Students are reminded that if they withdraw from the University they should return their student ID card to Kent Hospitality.

SECTION D: KENT SUPPORT SERVICES

D1 KENT SUPPORT SERVICES

Information on living and studying at Kent can be found at http://www.kent.ac.uk/student/

Accommodation

Please have a look at the Living section of the student portal website.
Accommodation Office, Tanglewood, Giles lane.
Tel No: 01227 766660 Fax No: 01227 823965.
Email: hospitality-enquiry@kent.ac.uk Website: www.kent.ac.uk/hospitality.

Careers Advisory Service

Please have a look at the Support section of the student portal.
Careers Advisory Service, Tel No: 01227 (82)3480 or (82)3481
Website: http://www.kent.ac.uk/careers/

The Chaplaincy Department

Please have a look at the Support section of the student portal.
The University Chaplaincy, Keynes College.
Tel No: 01227 824000
Email: chaplaincy@kent.ac.uk.

The Counselling Service

Please have a look at the Support section of the student portal.
The University Counselling Service, Room C2.4, Darwin College.
Tel No: 01227 823206.
Email: counselling@kent.ac.uk. Website: www.kent.ac.uk/counselling.

The Disability Support Unit

The serivice supports all disabled students during their time at the University and can assist with the following:

- applying for money to pay for specialist equipment (e.g. computers) and helpers (e.g. notetakers). See Disabled Students' Allowance page.
- arranging signers, notetakers and other support workers
- helping you find out if you have dyslexia.
- talking to your lecturers about particular help you may need in lectures and seminars
- discussing any special arrangements you need for exams.
- contacting other departments about specific assistance you may require.

Disability Support Unit, Keynes College, University of Kent at Canterbury,
Kent CT2 7NP (Via Keynes main entrance, Rooms Hg7-9.)
Open Monday to Friday: 9.30am to 1pm (please call in or make an appointment)
2pm to 5pm (appointments only)
Phone: 01227 823158 (voice or textphone).
Email: accessibility@kent.ac.uk Fax: 01227 823158
Useful Websites:
Disability Support Unit: www.kent.ac.uk/guidance/disabilityanddyslexiasupport.htm
Skill: National Bureau for Students with Disabilities: www.skill.org.uk
British Dyslexia Association: www.bda-dyslexia.org.uk

English Language Unit

The English Language unit at the university offers regular listening/speaking and writing classes in the English language. These are free of charge to registered students.
If you are interested, contact the English Language Unit (room G34, telephone extension 7648) between 2.00 - 4.00 pm Monday to Friday.

Equal Opportunities

The Kent Equal Opportunity Policy rejects all forms of discrimination, and comprehensive Student Guidelines outline ways of ensuring fair and consistent behaviour and provisions. These should be consulted if an issue arises which might have an e.o. dimension. The Guidelines cover recruitment, assessment, curriculum, accommodation and support services. Any member of staff is welcome to discuss these with the Equal Opportunity Officer if a particular concern arises. Alternatively, you may wish to consult the Departmental Equal Opportunity Representative. The Guidelines are available on Website:
www.kent.ac.uk/registry/personnel/policies/equal-opps/index.htm.
Harassment and Bullying is covered by the Harassment Policy which includes sexual, racial or disability harassment and homophobic behaviour, as well as personal harassment, e-mail misuse and stalking. Whether the relationship is student/student or student/staff, Harassment Contacts offer confidential support to help the student understand the stages of the Harassment Procedure, and to chose their preferred course of action. Students and staff may also contact the Equal Opportunity Officer direct. Each student should have received a paper copy of the procedure at Registration, which lists the Contacts. It is also available on the website below.
The Equal Opportunity Office, Personnel, The Registry,
Tel No: 01227 764000 ext.7825 or 3956. Email: stdev@kent.ac.uk
Website: www.kent.ac.uk/equalityanddiversity/

The International Office

The International Office manages a small Overseas Hardship Fund – this fund is small and can only make small grants which are very much in the nature of emergency funds. It is not funding to cover fees or accommodation costs. Hardship Application forms can be obtained from the International Office and must be accompanied by bank statements and other supporting information.
Any overseas student who has problems with the payment of fees or accommodation costs should, in the first instance, make an appointment to discuss their problems with the Income Office. It is important to keep up a dialogue with the Income Office if the imposition of supplementary charges are to be minimised or avoided.
Overseas Short-term students (not full degree students) from outside the EU should keep in touch with the International Office if they need assistance as we have a special administrative responsibility for them.
All Overseas (non-EU) students are strongly advised to complete their registration with a general practitioner (or the Medical Centre) if they live on or near the campus as soon as possible after arrival. Do not leave this until after an emergency happens as it may mean that treatment is not covered under the National Health Service. Completion and return of the medical form at the beginning of registration is not sufficient. The student must go to a General Practitioner and formally register.
The International Office, Registry, Tel No: 01227 (82)3905
Email: International-office@kent.ac.uk Website: www.kent.ac.uk/registry/intoffice

Masters

College Masters are responsible for the welfare and non-academic discipline of all the students in their college. They are a source of help and advice about students' general experience at the university including such concerns as accommodation, financial matters and relationships with other students, members of staff and members of the public. They are often the first point of contact when agencies external to the university have an interest in student matters. Anything revealed by students to Masters is treated in the strictest confidence. Masters' offices are open during normal working hours.
Master of Darwin College, Tel No: 01227 (82)7650 or Tel No: 01227 (82)3049
Master of Rutherford College, Tel No: 01227 (82)3175 or Tel No: 01227 (82) 3470
Master of Keynes College, Tel No: 01227 (82)7453 or Tel No: 01227 (82)7010
Master of Eliot College, Tel No: 01227 (82)3320 or Tel No: 01227 (82)3141

The Oaks Day Nursery

The Oaks provides childcare for staff and students. It is a very well used and popular resource and it is advised to book places well ahead of time.
The Oaks Day Nursery, Giles Lane. Tel No: 01227 766686 or 764000 ext. 7676

Security Services

Please have a look at the Living section of the student portal.
Email: estates@kent.ac.uk: Website: http://www.kent.ac.uk/estates/security/

University Nursing Service

Please have a look at the Support section of the student portal.
The University Nursing Service, Eliot College, University of Kent. Tel No: 01227 823503

The Sports Centre

Please have a look at the Having Fun section of the student portal.
The Sports Centre. Tel No: 01227 (82)7430 Website:www.kent.ac.uk/sports/index.html

Student Learning Advisory Service
If you need help with managing your time, writing essays or learning new exam preparation techniques, have a look at the Support section of the student portal.

Students Union Support Services

Please have a look at the links from the Students Union website.
Students Union, Mandela Building, Tel No: 01227 824200
Students Union webpages: www.kentunion.co.uk

Information and Guidance Unit
If you have any concerns or questions before embarking on a course of study, from financial problems to disabled access, why not talk to a member of staff? The University has an Information and Guidance Unit specially set up to help you with your queries; you can call, email or drop into the Canterbury office. Staff are also able to meet with students at Medway and the University's centre in Tonbridge.

You can contact the Unit for guidance on many aspects of study including the following:

- Impartial guidance about learning opportunities across Kent and Medway
- Part-time study options
- Information on learner support e.g. key skills, study support
- How to choose your course
- How to prepare for your course
- Funding and fees
- Leaflets on University services

For more specialist enquiries, we can direct you to the relevant person or department within the University, such as the Disability Unit or the Learning Support Team.

If you would like to speak with a member of the Information and Guidance Unit please call freephone 0800 975 3777. You can also email information@kent.ac.uk
The Unit is situated in the Information, Recruitment and Admissions Office within the registry building on the Canterbury campus and is open 9am-5pm, Monday to Friday.

University Medical Centre

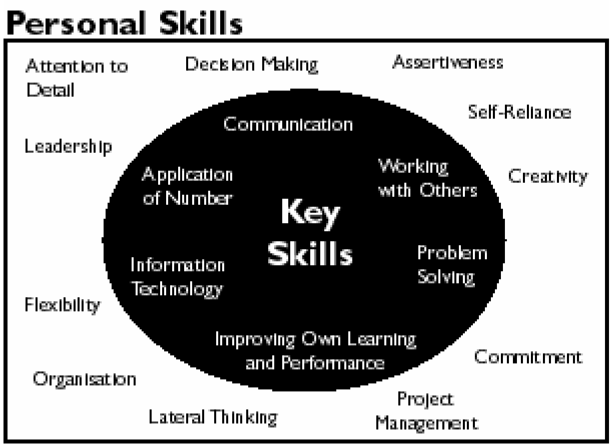
The University Medical Centre, Giles Lane. Tel No: 01227 (82)3583 or 01227 765682
Emergency calls out of hours 07860 518859 (night/weekends)
NHS Direct 24 hour advice and information Tel no: 0845 4647 or www.nhsdirect.nhs.uk
Email: medsecs@kent.ac.uk Website: http://www.kent.ac.uk/medical/index1.htm

D2. <u>SCHOOL OF PHYSICAL SCIENCES KEY SKILLS STATEMENT</u>

What are Key Skills?
Key skills developed in one context are useful in many others. They are personal and professional skills which enable you to perform effectively in University studies, graduate employment and your personal life. While there is no nationally agreed list of key skills, they are generally accepted as including:

- communication
- information technology
- numeracy
- problem solving
- team building
- improving one's own learning and performance

You will not necessarily acquire all of these skills from your degree course. Extra-curricular activities, part-time and vacation employment provide many opportunities for developing skills. The level at which you practise the different skills will probably vary and will depend on you as a person and on what you intend to do with your future.



Why do I need Key Skills?

Employers need staff who not only are good at science but also can operate as part of a team, have the potential to manage others, and can communicate clearly with a wide variety of people.

- These skills give you the confidence and ability to get more out of your degree studies, your University life and your vacation employment.
- Whether you go on to a higher degree or into paid or unpaid employment you will need to take responsibility for your own future learning and development.
- With the increased number of graduates, many more now enter careers not directly related to their academic studies and key skills are vital in enabling graduates to be effective in a new field.
- Business organisations have changed greatly, reacting to new technology, deregulation, recession, global competition and many other factors. The changes are happening fast and include delayering, customer-focusing, contracting-out and increased use of IT. If you are seeking such employment you will need the skills to cope with these new challenges and you will need to be flexible.
- Employers could not be clearer in the message they are sending out - they need graduates who can be useful to their business as soon as they arrive. They are looking for "effective students", ones who know their own abilities, academic and interpersonal, and can apply them.
  "The pace of change is reflected in the demands of employers for graduates who are *flexible and adaptable* … [and can] apply existing capabilities to new situations… [Graduates must be prepared to] take responsibility for their career and personal development and should be able to manage the relationship with work and learning throughout all stages of their lives."
  Skills for Graduates in the 21st Century, the Association of Graduate Recruiters.
- The traditional graduate trainee schemes are disappearing. One of the growth areas identified by the AGR (Association of Graduate Recruiters) in their report 'Skills for Graduates in the 21st Century' is graduate employment in the small and medium size enterprises (SME's). These organisations do not have the support structures of the large companies and graduates need to be self-reliant.

How can I develop Key Skills during my course?

- become aware of the variety of key skills
- plan your own skills development
- participate fully in all course activities
- participate in the Student Union Development programme
- attend selected development programmes coordinated by UELT http://www.kent.ac.uk/uelt/
- Utilise the Kent Personal Development Planner on http://spider.ukc.ac.uk/PDP/sitefiles/Keynote_PDP-sitefiles/index.htm and the Skills Menu provided by the careers advisory service on www.kent.ac.uk/careers/sk/skillsmenu.htm
  This is an important part of Personal Development Planning.

The following examples indicate some of the opportunities available to practise a particular skill during your degree course. With these in mind you should be able to set yourself realistic development targets. When you have looked up a particular skill, why not stop and think about how you could develop it

- through your coursework
- through your extra-curricular activities
- through part-time or vacation work.

Written communication

The ability to write concisely and convey meaning in a manner appropriate to different readers, presenting a persuasive argument.

How to develop the skill

- report writing
- essay writing
- poster designing
- writing for (student) newspaper
- secretary of societies - recording minutes of meeting

Oral communication

The ability to verbally express ideas to others or give a presentation in a clear and ordered manner, including use of PowerPoint and overhead projectors. Perhaps, simply, giving accurate instructions, or, more influentially, being a spokesperson.

How to develop the skill

- participation in tutorial groups/examples classes/workshops
- presentations to other students and academics
- committee work in societies, department or faculty
- volunteer for a Kent SU programme e.g. Student Tutoring Programme or Course Representation
- high flyers programme

Negotiating

The ability to influence another person and reach agreement on a contentious topic, through mediation or bargaining.

How to develop the skill

- Student Rep. on Staff/Student committee
- settling accommodation problems with landlord
- negotiating on behalf of Societies/Colleges

Numeracy

The ability to understand and interpret facts or ideas expressed in figures and non-verbal data. Enables you to estimate, spot accounting errors and manage a budget.

How to develop the skill

- processing laboratory data
- examples class and workshop problems
- UELT Maths and Statistics - Boosting Skills and Confidence workshops
- managing your own finances
- treasurer of Societies/College committee
- charity fundraising

Information retrieval

Locating, collecting, classifying and summarising information (including data) in a systematic way.

How to develop the skill

- researching and reading for essays, course work, tutorial assignments and projects
- SPS skills modules
- Templeman Library: Library Skills Workshops
- using information databases including the Web

- vac work e.g. in research or information management

Computer literacy

Knowing how to use a popular word processing, spreadsheet and database package, and how to use email and the Web.

How to develop the skill

- computer packages in coursework
- wordprocess academic work
- learn new computer packages through academic studies, vac. work, independently or take the European Computer Driving Licence
  http://www.kent.ac.uk/is/computing/training/ukc-students
- use email
- access the SPS Web-based PC-skills guides

Decision making

Evaluating available information, identifying options and reaching effective conclusions. Making decisions which can be realistically implemented and taking responsibility for them.

How to develop the skill

- practical assignments
- participating in employers' vacation placements/workshops
- holding office with responsibility for events or budgets
- making career decisions
- choosing optional courses

Teamwork

Working with others to effectively achieve a goal; involving co-operation, being sensitive, listening to other team members, sharing ideas.

How to develop the skill

- workshops and laboratory classes
- project work - sharing observations and analysis
- vacation work
- voluntary work
- team sports
- committee work - Students Union, Societies, Colleges
- charity fund-raising

Improving One's Own Learning and Performance

The ability to assess your own strengths and weaknesses and to take action to improve personal competencies such as study skills (improving your concentration, note taking, exam revision), *time management* (prioritising tasks), *stress management* (adaptability, flexibility). Involves thinking ahead, requires tenacity and encourages autonomy.

How to develop the skill

- organisation of practical/laboratory work
- working under pressure to meet deadlines, e.g. submitting coursework on time
- networking
- getting a good balance between your studies and extra curricular activities
- adapting to changes in your life, e.g. from home to university
- assessing your own skills development and improving your skills
- Attending UELT workshops
- VALUE programme http://www.kent.ac.uk/uelt/learning/value/index.html

Project management

The ability to set objectives and time scales, to monitor them and see them through to completion. Working under pressure to meet deadlines.

How to develop the skill

- degree course project work
- vacation project work
- voluntary project work - e.g. through committees or S.U. work

Planning

Reflecting and setting attainable goals; scheduling the sequence of work to achieve your goals.

How to develop the skill

- planning course work and leisure activities
- planning skills development and completing your skills action plans
- setting long-term goals e.g. planning your career, organising overseas travel or a year out

Critical analysis

The ability to evaluate information and, for most effective use, abstract just the relevant data.

How to develop the skill

- in academic studies e.g. reading, problem solving
- in committee work

Commercial awareness

Having an interest in and understanding of some of the economic considerations in business.

How to develop the skill

- participation in Student Science Societies
- use vacation work to find out about how businesses are run
- use the Web to find out information on companies
- reading newspapers, the Economist, popular science journals

Problem solving

The ability to identify the key issues of a problem, and to then use your knowledge and understanding to find a creative and appropriate solution. This may involve conceptual thinking, analytical thinking, strategic thinking, thinking on your feet, innovativeness and improvisation.

How to develop the skill

- workshops and tutorials
- research project work
- attending employers' vacation placement/workshops
- management business games
- organising (social) events for college or student society
- dealing with accommodation problems or travel plans
- work-based projects in vacations
- volunteer for a Kent SU programme eg Rag

Personal Development Planning (PDP)

Personal Development Planning (PDP) is part of the HE Progress File. The Progress File contains within it:

- Institutional records of learning and achievement (transcripts);
- An individual's own personal development records and reflections of their learning, achievements, plans and goals;
- Personal development planning - a process that is undertaken by the individual to reflect upon their own learning and achievement and to plan for their own educational, academic and career development.

The term personal development planning is used in order to emphasise that this is an active learning process undertaken by individuals for themselves.

What is PDP intended to do?

PDP is intended to help students:

- Become more effective, independent and confident self- directed learners;
- Understand how they are learning and relate their learning to a wider context;
- Improve their general skills for study and career management;
- Articulate their personal goals and evaluate progress towards achievement;
- Be more effective at monitoring and reviewing their own progress;
- Recognise and discuss their own strengths and weaknesses;
- Be better prepared for seeking employment, or self-employment, and be more able to relate what they have learnt to the requirements of the employer;
- Be better prepared for the demands of continuing professional or vocational development, when they enter employment.

Implementation at the University of Kent

PDP at the University of Kent is conducted via an on-line system, rather than a paper-based system. This system, called “Keynote”, allows for students to download and save pages and print out their own word documents. The system is student owned and operated. A student creating any PDP documentation owns the document. The individual student decides what might be shown to, or discussed with, a tutor or academic advisor.

The “Keynote” system is at:
http://spider.kent.ac.uk/PDP/sitefiles/Keynote_PDP-sitefiles/index.htm

and further details about PDP are at: http://www.kent.ac.uk/uelt-local/PDP/

SECTION E: TEACHING AND STAFF ROOM LOCATIONS

E1. DETAILS OF TEACHING ROOMS 2007/2008

Please Note: No smoking, eating or drinking is allowed in any teaching room.

	ROOM	ROOM TYPE	LOCATION
	CORNWALLIS - COMPUTING BUILDING		
♿	COLT2(100)	Lecture theatre	Ground floor
♿	CC01(18)	Terminal room	Ground floor
♿	CC02(32)*	Terminal room	1st floor
♿	CC03(18)	Terminal room	Ground floor
♿	CC04(16)	Terminal room	Ground floor
	* Wheelchair access via lift in Computing Octagon		
	CORNWALLIS - GULBENKIAN WING		
♿	COLT1(300)	Lecture theatre	Ground floor
♿	CGU2(24)	Classroom	Ground floor
	CGU3(24)	Classroom	1st floor
	CGU4(58)	Lecture theatre	1st floor
	CORNWALLIS - INSTITUTE OF MATHEMATICS & STATISTICS		
♿	MathsLT(80)	Lecture theatre	Ground floor
	CORNWALLIS - NORTH EAST WING		
♿	CNESem08(30)	Seminar room	Ground floor
	CORNWALLIS - NORTH WEST WING		
♿	CNWSem1(16)	Seminar room	Ground floor
♿	CNWSem2(16)	Seminar room	Ground floor
♿	CNWSem3(30)	Seminar room	Ground floor
♿	CNWSem4(30)	Seminar room	Ground floor
♿	CNWSem5(30)	Seminar room	Ground floor
♿	CNWSem6(30)	Seminar room	Ground floor
♿	CNWSem7(30)	Seminar room	Ground floor
	CNWSem8(18)	Seminar room	3rd floor
	CNWSem9(16)	Seminar room	3rd floor
♿	CNWsem10(24)	Library	Ground floor
♿	CNWsem11(18)	Seminar room	Ground floor
♿	CNW Lab 2(15)*	Classroom	2nd floor
	* Wheelchair access via the lift in Cornwallis George Allen		
	GILES LANE TEACHING ANNEX (at rear of Biology)		
♿	GLS1(20)	Seminar room	Ground floor
♿	GLS2(16)	Seminar room	Ground floor
♿	GLS3(40)	Seminar room	Ground floor
♿	GLS4(18)	Seminar room	Ground floor
♿	GLS5(18)	Seminar room	Ground floor
♿	GLS6(25)	Seminar room	Ground floor
♿	GLS7(30)	Seminar room	Ground floor
♿	GLS8(18)	Seminar room	Ground floor
♿	GLS10(40)	Seminar room	Ground floor

GRIMOND BUILDING

♿	GLT1(198)	Lecture theatre	Ground floor
♿	GLT2(142)	Lecture theatre	Ground floor
♿	GLT3(98)	Film theatre	Ground floor
♿	GS1(20)	Seminar room (Film Studies only)	Ground floor
♿	GS2(20)	Seminar room (Film Studies only)	Ground floor
♿	GS3(24)	Classroom	Ground floor
♿	GS4(18)	Seminar room (Film Studies only)	Ground floor
♿	GS5(20)*	Seminar room	1st floor
♿	GS6(22)*	Classroom	1st floor
♿	GS7(22)*	Classroom	1st floor
♿	GS8(18)*	Seminar room	1st floor

* Wheelchair access via lift

LABORATORIES

Biology

♿	BLT1(120)*	Lecture theatre	1st floor
♿	BLT2(37)*	Lecture theatre	1st floor
♿	I316(20)*	Seminar Room	3rd floor

* Wheelchair access via lift

INGRAM

♿	PSLT(60)	Lecture theatre	Ground floor

Electronics

♿	EleLT(91)	Lecture theatre	Ground floor
♿	ElecSem1(20)	Lecture room	Ground floor
♿	ElecSem2(10)*	Seminar room	1st floor
♿	ElecSem3(38)*	Seminar room	1st floor
♿	Multimedia Lab A(40)	Terminal	Ground floor
♿	Multimedia Lab B(40)	Terminal	Ground floor
♿	Multimedia Lab C(20)	Terminal	Ground floor

* Wheelchair access via lift

Marlowe

♿	MarLT1(150)	Lecture theatre	Ground floor
♿	MarLT2(50)	Lecture theatre	Ground floor

DARWIN COLLEGE

♿	DLT1(96)	Lecture theatre	Level 1, A block
♿	DLT2(54)	Lecture theatre	Level 1, A block
♿	DLT3(55)*	Lecture theatre	Level 4, Tower block
	D.Twr.Rm.(25)	Seminar room	Level 5, Tower block
♿	DS1(26)*	Seminar room	Level 3, A block
	DS2(20)	Seminar room	Level 6, Tower block
	DS7(26)	Seminar room	Level 5, Tower block
♿	DS8(15)	Seminar room	Missing Link
♿	DS9(16)	Seminar room	Missing Link
♿	DS10(12)	Seminar room	Missing Link
♿	DS11(12)*	Seminar room	Level 2, G/H block
♿	DS12(12)*	Seminar room	Level 2, O/P block
♿	DS14(12)*	Seminar room	Level 4, Tower block
♿	D.Peter Brown Room(40)	Seminar room	Missing Link

* Wheelchair access via lift

ELIOT COLLEGE

		Main college	
♿	ELT2(114)*	Lecture theatre	Floor 3, N block
♿	E.Dr.St.(40)*	Drama Studio	Floor 3, N block
♿	E.Chilver Room(16)	Seminar room	Cloister
	E.Holland Room(16)	Seminar room	Cloisters
	E.Lyons Room(35)	Informal room	Top floor
	E.Peter Bird Room(15)	Seminar room	Cloisters
♿	E.Pollard Room(16)	Seminar room	Cloisters
♿	E.Whitehouse Room	Seminar room	1st floor
	* Wheelchair access via causeway		
♿	ES1(30)	Seminar room	Floor 4, N block
♿	ES2(22)	Seminar room	Floor 4, N block
♿	ES3(20)	Seminar room	Floor 4, N block
	KLS Meeting Rm	Informal Room	Floor 4, E Block
		Extension	
♿	EX7(20)	Seminar room	Upper floor
♿	EX8(20)	Seminar room	Upper floor
♿	EX9(20)	Seminar room	Upper floor
♿	EX10(20)	Seminar room	Upper floor
♿	E.Dice Room	Seminar room	Upper floor
		Becket Court	
	E.BCSem 16(20)	Seminar room	Ground floor
	E.BCSem 17(20)	Seminar room	Ground floor

KEYNES COLLEGE

♿	KLT1(344)	Lecture theatre	Lwr grnd floor
	KLT2(60)	Lecture theatre	Lwr grnd floor, N block
	KLT3(60)	Lecture theatre	Lwr grnd floor, N block
♿	KLT4(130)*	Lecture theatre	Psychology Dept
♿	KLT5(90)	Lecture theatre	1st floor L Block
♿	KLT6(92)	Lecture theatre	1st floor L Block
♿	KLSR4(40)	Classroom	Ground floor, N block
♿	KS1(24)*	Seminar room	1st floor, N block
♿	KS2(16)*	Seminar room	1st floor, N block
♿	KS3(12)*	Seminar room	1st floor, N block
♿	KS5(16)*	Seminar room	1st floor, N block
♿	KS6(24)*	Seminar room	1st floor, N block
♿	KS7(24)	Seminar room	Ground floor, M block
♿	KS8(25)*	Seminar room	Psychology Dept
♿	KS9(20)*	Seminar room	Psychology Dept
♿	KS10(15)*	Seminar room	Psychology Dept
♿	KS11(24)	Seminar room	1st floor L Block
♿	KS12(30)	Seminar room	1st floor L Block
♿	KS13(45)	Seminar room	1st floor L Block
♿	KS14(45)	Seminar room	1st floor L Block
♿	KS15(45)	Seminar room	1st floor L Block
♿	KS16(40)	Seminar room	1st floor L Block
♿	KS17(40)	Seminar room	1st floor L Block
♿	KSA1(40)	Terminal room	1st floor, N block

* Wheelchair access via lift opposite College Reception

RUTHERFORD COLLEGE

Main college

♿	RLT1(200)*	Lecture theatre	Floor 3, W block
♿	RLT2(40)*	Lecture theatre	Floor 3, W block

* Wheelchair access via causeway to main entrance

♿	RS4(20)	Seminar room	Floor 4, W block
♿	RS5(20)	Seminar room	Floor 4, W block
♿	RS6(16)	Seminar room	Floor 4, W block
	CIS Rooms	Workshops	Floor 3, W block
♿	R.Cl.15(16)*	Seminar room	Cloisters
♿	R.Cl.16(16)*	Seminar room	Cloisters
♿	R.Cl.17(16)*	Seminar room	Cloisters
♿	R.Cl.19(16)*	Seminar room	Cloisters
♿	R.Cl.20(16)*	Seminar room	Cloisters
♿	R.Cl.21(16)*	Seminar room	Cloisters

* Wheelchair access via west exit or kitchens

Extension

♿	RX9(18)	Seminar room	Upper floor
♿	RX10(30)	Classroom	Upper floor
♿	RX11(27)*	Seminar room	Lower floor
♿	RX12(27)*	Classroom	Lower floor

* Wheelchair access via courtyard garden

E2. STAFF ROOMS AND E-MAIL ADDRESSES

NAME	E-MAIL	ROOM No in Ingram Building
Dr R E Benfield	R.E.Benfield@kent.ac.uk	313
Dr S Biagini	S.Biagini@kent.ac.uk	317
Dr L L Boyle	L.L.Boyle@kent.ac.uk	315
Dr M J Burchell	M.J.Burchell@kent.ac.uk	119
Professor A V Chadwick	A.V.Chadwick@kent.ac.uk	219
Dr G Dobre	G.Dobre@kent.ac.uk	107
Dr D Froebrich	df@star.kent.ac.uk	117
Dr S J Holder	S.J.Holder@kent.ac.uk	319
Mr M Johnson	M.R.Johnson@kent.ac.uk	111
Dr A Kanagasooriam	ajssk@kent.ac.uk	111
Dr P J Lindan	P.Lindan@kent.ac.uk	217
Dr J Q Miao	J.Miao@kent.ac.uk	115
Dr G Mountjoy	G.Mountjoy@kent.ac.uk	215
Professor R J Newport	R.J.Newport@kent.ac.uk	213
Dr A Podoleanu	A.G.H.Podoleanu@kent.ac.uk	301
Dr D O Smith	D.O.Smith@kent.ac.uk	G44/G42
Professor M D Smith	M.D.Smith@kent.ac.uk	101
Professor P Strange	P.Strange@kent.ac.uk	201
Dr C J Solomon	C.J.Solomon@kent.ac.uk	109
Dr M J Went	M.J.Went@kent.ac.uk	311

Departmental Administrator

Mr J.R. Redmond	J.R.Redmond@kent.ac.uk	211a

Student Administration

Ms K L Harty Mrs M A Fowler	spsadmin@kent.ac.uk	209