Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 2 (FHEQ LEVEL 5)

BSC PHYSICS WITH PARTICAL PHYSICS AND COSMOLOGY DEGREE PROGRAMMES

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2022-23

DISCLAIMER

The Faculty of Science and Engineering has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The Faculty of Science and Engineering reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules. You are advised to contact the Faculty of Science and Engineering directly if you require further information.

The 22-23 academic year begins on 19 September 2022

Full term dates can be found here

DATES OF 22-23 TERMS
19 September 2022 – 16 December 2022
9 January 2023 – 31 March 2023
24 April 2023 – 09 June 2023

SEMESTER 1
19 September 2022 – 27 January 2023
SEMESTER 2
30 January 2023 – 09 June 2023
SUMMER
12 June 2023 – 22 September 2023

IMPORTANT

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism**, **Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance here and further information here. You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity. You should also refer to the Faculty of Science and Engineering proof-reading policy and this can be found on the Community HUB on Canvas, under Course Documents.

Welcome to the Faculty of Science and Engineering!

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

This has been a challenging period for everyone. The COVID-19 pandemic has prompted a huge change in society as well as how we deliver our programmes at Swansea University and the way in which you study, research, learn and collaborate. We have been working hard to make sure you will have or continue to having an excellent experience with us.

We have further developed some exciting new approaches that I know you will enjoy, both on campus and online, and we cannot wait to share these with you.

At Swansea University and in the Faculty of Science & Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone. Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic staff, administrators, and your fellow students - I'm sure you will find many friendly helping hands ready to assist you.

We all know this period of change will continue and we will need to adapt and innovate to continue to be supportive and successful. At Swansea we are committed to making sure our students are fully involved in and informed about our response to challenges.

In the meantime, learn, create, collaborate, and most of all – enjoy yourself!

Professor Johann (Hans) Sienz
Interim Pro-Vice Chancellor/Interim Executive Dean
Faculty of Science and Engineering

Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Paul Holland
School of Biosciences, Geography and Physics **Head of School: Siwan Davies**	
School Education Lead	Dr Laura Roberts
Head of Physics	Dr Daniel Thompson and Professor Prem Kumar
Physics Programme Director	Professor David Dunbar
Year Coordinators	Year 0 – Dr Warren Perkins Year 1 – Dr Timothy Burns Year 2 – Professor Ardalan Armin Year 3 – Professor Timothy Hollowood Year M – Dr Kevin O'Keeffe

STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 9am-5pm.

The **Student Support Team** provides dedicated and professional support to all studentsin the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

Email: studentsupport-scienceengineering@swansea.ac.uk (Monday–Friday, 9am–5pm)

Call: +44 (0) 1792 295514 and 01792 6062522 (Monday-Friday, 10am–12pm, 2–4pm).

Zoom: By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to otherresources:

https://myuni.swansea.ac.uk/fse/coe-student-info/

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via http://ifindreading.swan.ac.uk/. We've removed reading lists from the 22-23 handbooks to ensure that you have access to the most up-to-date versions. Access to print material in the library may be limited due to CV-19; your reading lists will link to on-line material whenever possible. We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

Compulsory modules must be **pursued** by a student.

Core modules must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under "Modular Terminology" on the following link - https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-info-taught-students/your-programme-explained/

Year 2 (FHEQ Level 5) 2022/23
Physics with Particle Physics and Cosmology
BSc Physics with Particle Physics and Cosmology[F3F5]

Compulsory Modules

Semester 1 Modules	Semester 2 Modules
PH-203 **Statistical Physics** **10 Credits** **Prof M Piai**	**PH-207** **Condensed Matter Physics I** **10 Credits** **Dr JE Bateman**
PH-204 **Physics Simulation** **10 Credits** **Dr JE Bateman**	**PH-222** **Electromagnetism II** **10 Credits** **Dr WB Perkins**
PH-205 **Quantum World II** **10 Credits** **Prof C Nunez**	**PH-227** **Mathematical Methods in Physics II** **10 Credits** **Prof DC Dunbar**
PH-206 **Mathematical Methods in Physics I** **10 Credits** **Dr S Basiri Esfahani/Dr CJ Barnett**	**PH-229** **Particle Physics I** **10 Credits** **Dr EI Zavala Carrasco**
PH-221 **Electromagnetism and Special Relativity I** **10 Credits** **Prof C Nunez**	**PH-320** **Foundations of Astrophysics** **10 Credits** **Prof SP Kumar**
Total 120 Credits	

Optional Modules

Choose exactly 10 credits

PH-211	Laboratory Physics 2 and Group Projects	Prof DP Van Der Werf/Dr CA Isaac	TB2	10
PH-211C	Ffiseg Labordy 2 a Phrosiectau Grwp	Prof DP Van Der Werf/Dr CJ Barnett/Dr CA Isaac/..	TB2	10

And

Choose exactly 10 credits

PH-210	Laboratory Physics 2 and Group Projects	Dr CA Isaac/Prof DP Van Der Werf	TB1	10
PH-210C	Ffiseg Labordy 2 a Phrosiectau Grwp	Dr CA Isaac/Dr CJ Barnett	TB1	10
PH-216	Professional Development and Career Planning	Mr N Clarke/Miss VV Wislocka	TB1	0

PH-203 Statistical Physics

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof M Piai

Format: 22 lectures, 3 feedback sessions

Delivery Method: Lectures and feedback sessions.

Module Aims: The aim of this module is to derive thermodynamics from the fundamental laws of microscopic physics and to introduce the student to the fundamental aspects of classical and quantum statistical physics. Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics will be discussed.

Module Content: 1. Review of thermodynamics: thermodynamic parameters, macrostates, equation of state, laws of thermodynamics, thermodynamic potentials, Maxwell relations.
2. Elements of analytical mechanics: phase space, microstates, Hamiltonian systems.
3. Classical statistical mechanics, microcanonical ensemble, Boltzmann law, equipartition theorem.
4. Towards quantum statistical mechanics: Planck constant, Gibbs paradox, Boltzmann counting, third law of thermodynamics, violations of equipartition theorem.
6. Classical and quantum canonical ensemble: partition function.
7. Classical and Quantum Grand canonical ensemble: grand partition function.
8. Quantum gas: Fermi-Dirac and Bose-Einstein distribution. Maxwell-Boltzmann distribution.

Intended Learning Outcomes: An advanced understanding of thermodynamics based on the implementation of Maxwell's Thermodynamic relations, particularly relationships associated with heat capacities and non-ideal gases.
An understanding of the relationship between observed macrostate properties of a system and the microstate of the system, in particular the concept of ensemble average and the application of distributions.
To be able to derive the thermodynamic properties of a system from the laws of microscopic dynamics.
To be able to derive different distributions depending on the properties of the microscopic system of particles.
The ability to apply both classical and quantum mechanical distributions.
Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.
Students will be able to demonstrate that they have mastered the content of the module by being able to define and summarize important terms and concepts, recall key formulae without the aid of text books or other sources.

Assessment: Examination 1 (70%)
Coursework 1 (30%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination (70%): 2 hour written exam.
Coursework (30%)

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

PH-204 Physics Simulation

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr JE Bateman

Format: 22 lectures (11 x 1-hour computer-based sessions and 11 x 2-hour computer-based sessions), 3 feedback sessions

Delivery Method: Lectures, practical computer sessions, and feedback sessions.

Module Aims: This course is a mixture of "hands-on" practice with real computer-based problems, a theoretical overview of the commonly used numerical methods, and a further refinement of computer programming skills. Throughout the course, practical physics examples will be given to illustrate the methods being taught. It is intended that students will build up a library of software techniques for later use.

Module Content: 1. Introduction to the Python programming language.
2. Interpolation.
3. Integration.
4. Solving an equation of one variable by linear and iterative methods.
5. Solution of differential equations, Euler, mid-point and Runge-Kutta, orbit problems.
6. Use of Mathematica in solving Physics problems.

Intended Learning Outcomes: Students will understand that some of the many physics problems that cannot be solved in analytic form may be tackled numerically. Students will gain a working knowledge of some of the main techniques in computational studies, such as interpolation, the solution of differential equations, etc.
Students will become practised in applying these techniques to real physics problems, such as orbit problems and finite difference problems.
Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.

Assessment: all (100%)
Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Continuous Assessment.

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

PH-205 Quantum World II

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof C Nunez

Format: 22 lectures, 3 feedback sessions

Delivery Method: Lectures and feedback sessions.

Module Aims: "The student will learn basics of Quantum Mechanics. Basically, the infinite square well, some problems with simple potentials and solving the Scroedinger equation.

Then the oscillator is studied, using the perspective of creation and anhilatation operators, so useful in Quantum Field Theory.
Finally, basics of the angular momentum in Quantum Mechanics is covered.

The module has a view on simple calculable problems, the effect of measurement and the idea of a complete basis of states, ideas that repeat themselves in all the cases above mentioned."

Module Content: 1. The limits of classical physics
2. The wave function, Born interpretation, normalisation, definition of <x>
3. The time dependent (TDSE) and independent (TISE) Schrodinger equations
4. Stationary states
5. Infinite and Finite Square Well
6. Qualitative discussion of non-stationary states, transitions and tunnelling.
7. Free particles and scattering from potential barriers
8. Operators, observables, expectation values
9. Eigenstates, eigenvalues, and standard deviations
10. Commutation relations and the Uncertainty Principle: wave packets
11. Harmonic Oscillator via both TISE and ladder operators
12. Three dimensional square well: degeneracy and quantum numbers
13. Angular momentum: operators, commutation relations and eigenstates
14. The Stern-Gerlach experiment

Intended Learning Outcomes: By completion of the course the student will have a grasp of the fundamental principles of quantum mechanics, and be prepared for their application in further courses on atomic physics, solid state physics and spectroscopy.

Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.

Students will be able to demonstrate that they have mastered the content of the module by being able to define and summarize important terms and concepts, recall key formulae without the aid of text books or other sources.

Assessment: Examination 1 (70%)
Coursework 1 (30%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination (70%): 2 hour written exam.
Continuous Assessment (30%): 2 pieces of coursework

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

PH-206 Mathematical Methods in Physics I

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr S Basiri Esfahani, Dr CJ Barnett

Format: 22 lectures, 3 feedback sessions

Delivery Method: Lectures and feedback sessions.

Module Aims: The description of electric and magnetic fields in space in terms of vector analysis and multiple integration is developed. Properties of matrices and their eigenvectors relevant to quantum mechanics are explained.

Module Content: 1. Double and repeated integrals and physical applications, cartesian and polar co-ordinates.
2. Triple integrals.
3. Force fields, work done by force, line integrals.
4. Conservative forces, potential energy, equipotential surfaces.
5. Stokes theorem in the plane.
6. Gauss' theorem.
7. Recap of the integral theorems, statement of Maxwell's equations.
8. Matrices acting on column vectors and their multiplication.
9. Solution of linear equations, inverse and determinant of a matrix.
10. Notion of a eigenvalue and eigenvector, characteristic of a matrix.
11. Hermitian conjugation, hermitian matrices, reality of eigenvalues, orthonormality and completeness of their eigenvectors.
12. unitary matrices, exp (matrix).
13. Spherical polar co-ordinates in detail.

Intended Learning Outcomes: Skills in applying vector calculus and integral theorems to problems in electromagnetic theory and other branches of physics. Familiarity with concepts of eigenvalues and eigenfunction as relevant to measurement in quantum physics.

Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.

Students will be able to demonstrate that they have mastered the content of the module by being able to define and summarize important terms and concepts, recall key formulae without the aid of text books or other sources.

Assessment: Examination 1 (70%)
Coursework 1 (30%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination (70%): 2 hour written exam.
Continuous Assessment (30%): 2 pieces of coursework

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

PH-207 Condensed Matter Physics I

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules: PH-203; PH-205

Lecturer(s): Dr JE Bateman

Format: 22 lectures, 3 feedback sessions

Delivery Method: Lectures and feedback sessions.

Module Aims: The object of this module is to teach the basic concepts of modern solid state physics.

Module Content: Lattice I:
- Crystal structure: mathematics, common structures.
- X-ray diffraction: von Laue condition, powder camera.
- Bonding types: molecular, ionic and covalent crystals, metals (descriptive).
- Interatomic potentials: general, ionic (Madelung constant), 6,12 potential.

Lattice II:
- Phonons: lattice vibration, equipartition, modes for monatomic and diatomic lattices, dispersion relations.

Lattice III:
- Lattice heat capacities: Einstein and Debye models.
- k-states.

Lattice IV:
- Drude model: DC, AC, Hall, specific heat, and Wiedemann--Franz law.
- Sommerfeld: Pauli principle, Fermi-Dirac distribution, Fermi surface, specific heat.
- Density of states, introduction to band structure, semiconductors and doping."

Intended Learning Outcomes: An understanding of common lattice structures found in nature and their properties.
An understanding of the basic concepts of solid state physics.
The use of fundamental physical laws in solving problem in a number of practical but challenging situations.

Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.

Students will be able to demonstrate that they have mastered the content of the module by being able to define and summarize important terms and concepts, recall key formulae without the aid of text books or other sources.

Assessment: Examination 1 (70%)
Coursework 1 (30%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination (70%): 2 hour written exam.
Continuous Assessment (30%): 2 pieces of coursework

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

PH-210 Laboratory Physics 2 and Group Projects

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr CA Isaac, Prof DP Van Der Werf

Format: 60

Delivery Method: Laboratory practical.

Module Aims: The objective of this module is for students to carry out a range of physical measurements and to collate data in a structured manner. Students will be familiarised with various software packages for the collation, analysis and representation of data. They will be expected to keep neat and comprehensive laboratory notebooks, and to write lucid reports of their experiments. The students will also get experience of working within a team (or group) environment on a five-week project.

Module Content: The following are some examples of the experiments to be undertaken:-

Electron spin resonance, Franck Hertz measurement, Measurement of viscosity, Hydrogen Balmer Series, Calibrating a spectrometer using the Edser Butler Method, Hubble's law, Density of States, Numerical Analysis, optical diffraction experiments, e/m of an electron, The Hall Effect, Rutherford Scattering and B-H curve.

Recent group projects have included:

Cosmic Ray detection, Gamma Ray spectroscopy, Light emitting diodes, Neutrino Physics, Nuclear fusion, Quantum technologies, The Large Hadron Collider, Under 'a tenner' Physics, and Total internal reflection.

Intended Learning Outcomes: 1. Developing further experience in technical comprehension and the extracting of important information given within the laboratory scripts.
2. Further experience in carrying out more advanced laboratory experiments including keeping a comprehensive laboratory diary (record) and the full analysis of results.
3. Practice in writing high quality reports and conforming to rigid guidelines and deadlines.
4. An enhanced understanding of physics resulting from performing practical experiments.
5. Experience of group/team working and organisation.
6. Experience of the oral presentation by individually reporting key project elements as part of a team presentation.

Assessment: all (100%)
Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Continuous Assessment

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Assessment is conducted via on-line pre-experimental preparation (PEP) tests, which generates automatic but targeted feedback based upon results of the test. Laboratory diaries are assessed and graded with detailed feedback written inside the lab diary. Reports form part of the assessment and are returned with a detailed mark sheet to give personalised feedback via a breakdown of key aspects of the report. Oral presentations are graded with personalised feedback available from project supervisors.

Failure Redemption: Provide additional coursework.

Additional Notes: Available to visiting or exchange students.

PH-210C Ffiseg Labordy 2 a Phrosiectau Grwp

Credits: 10 **Session:** 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr CA Isaac, Dr CJ Barnett

Format: 60

Delivery Method: Ymarferol mewn labordy

Module Aims: Amcan y modiwl hwn yw i fyfyrwyr i wneud amrywiaeth o fesuriadau ffisegol ac i gasglu'r data mewn modd strwythuredig. Bydd myfyrwyr yn dod i arfer â gwahanol becynnau o feddalwedd ar gyfer coladu, dadansoddi a chynrychioli data. Bydd disgwyl iddynt gadw llyfrau labordy taclus a cynhwysfawr, ac i ysgrifennu adroddiadau eglur o'u harbrofion. Bydd y myfyrwyr hefyd yn cael profiad o weithio mewn amgylchedd tîm (neu grp) ar brosiect pum wythnos.

Module Content: Mae'r canlynol yn rhai enghreifftiau o'r arbrofion i'w gwneud:-

Cyseiniant sbin electron, Mesuriad Franck-Hertz, Mesuriad o gludedd, Cyfres Balmer Hydrogen, Graddnodi sbectromedr gan ddefnyddio dull Edser Butler, Deddf Hubble, Dwysedd cyflyrau, Dadansoddiad rhifol, Arbrofion diffreithiant optegol, e/m electron, Yr effaith Hall, Cromlin B-H.

Mae prosiectau grp diweddar wedi cynnwys:

Canfod pelydrau cosmig, Sbectrosgopeg pelydrau gama, Deuodau allyrru golau, Ffiseg niwtrino, Ymasiad niwclear, Technolegau Cwantwm, Yr LHC, Ffiseg dan deg-punt a Adlewyrchiad mewnol cyflawn.

Intended Learning Outcomes: 1. Datblygu profiad pellach mewn cynhwysiaeth dechnegol ac echdynnu gwybodaeth bwysig a roddir o fewn y sgriptiau labordy.
2. Profiad pellach wrth gynnal arbrofion mwy datblygedig gan gynnwys cadw dyddiadur labordy (cofnod) a dadansoddiad llawn o'r canlyniadau.
3. Ymarfer ysgrifennu adroddiadau o ansawdd uchel a chydymffurfio â chanllawiau a therfynau amser anhyblyg.
4. Dealltwriaeth well o ffiseg yn deilio o berfformio arbrofion ymarferol.
5. Profiad o weithio a threfniadaeth mewn tîm/grp.
6. Profiad o'r cyflwyniad llafar gan adroddiad unigolyn o gydrannau allweddol prosiect fel rhan o gyflwyniad tîm.

Assessment: all (100%)
Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Gwaith-cwrs

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Caiff asesiad ei gynnal drwy gyfrwng brofion paratoad cyn-arbrofol (PEP) ar-lein sy'n cynhyrchu adborth awtomatig, ond sydd wedi'u targedu yn seiliedig ar ganlyniadau'r prawf. Caiff dyddiaduron labordy eu hasesu a'u graddio gydag adborth manwl a ysgrifennwyd y tu mewn i'r dyddiadur labordy. Mae adroddiadau'n ffurfio rhan o'r asesiad ac yn cael eu dychwelyd gyda thaflen marcio fanwl i roi adborth personol trwy ddadansoddiad o agweddau allweddol yr adroddiad. Caiff cyflwyniadau llafar eu graddio gydag adborth personol ar gael o oruchwylwyr y prosiect.

Failure Redemption: Darparu gwaith cwrs ychwanegol.

Additional Notes: Ar gael i fyfyrwyr sy'n ymweld ac yn cyfnewid.

PH-211 Laboratory Physics 2 and Group Projects

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof DP Van Der Werf, Dr CA Isaac

Format: 60

Delivery Method: Laboratory practical.

Module Aims: The objective of this module is for students to carry out a range of physical measurements and to collate data in a structured manner. Students will be familiarised with various software packages for the collation, analysis and representation of data. They will be expected to keep neat and comprehensive laboratory notebooks, and to write lucid reports of their experiments. The students will also get experience of working within a team (or group) environment on a five-week project.

Module Content: The following are some examples of the experiments to be undertaken:-

Electron spin resonance, Franck Hertz measurement, Measurement of viscosity, Hydrogen Balmer Series, Calibrating a spectrometer using the Edser Butler Method, Hubble’s law, Density of States, Numerical Analysis, optical diffraction experiments, e/m of an electron, The Hall Effect, Rutherford Scattering and B-H curve.

Recent group projects have included:

Cosmic Ray detection, Gamma Ray spectroscopy, Light emitting diodes, Neutrino Physics, Nuclear fusion, Quantum technologies, The Large Hadron Collider, Under 'a tenner' Physics, and Total internal reflection.

Intended Learning Outcomes: 1. Developing further experience in technical comprehension and the extracting of important information given within the laboratory scripts.
2. Further experience in carrying out more advanced laboratory experiments including keeping a comprehensive laboratory diary (record) and the full analysis of results.
3. Practice in writing high quality reports and conforming to rigid guidelines and deadlines.
4. An enhanced understanding of physics resulting from performing practical experiments.
5. Experience of group/team working and organisation.
6. Experience of the oral presentation by individually reporting key project elements as part of a team presentation.

Assessment: all (100%)
Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Coursework

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Assessment is conducted via on-line pre-experimental preparation (PEP) tests, which generates automatic but targeted feedback based upon results of the test. Laboratory diaries are assessed and graded with detailed feedback written inside the lab diary. Reports form part of the assessment and are returned with a detailed mark sheet to give personalised feedback via a breakdown of key aspects of the report. Oral presentations are graded with personalised feedback available from project supervisors.

Failure Redemption: Submit additional coursework.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Not available to visiting and exchange students.

PH-211C Ffiseg Labordy 2 a Phrosiectau Grwp

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof DP Van Der Werf, Dr CJ Barnett, Dr CA Isaac

Format: 60

Delivery Method: Ymarferol mewn labordy

Module Aims: Amcan y modiwl hwn yw i fyfyrwyr i wneud amrywiaeth o fesuriadau ffisegol ac i gasglu'r data mewn modd strwythuredig. Bydd myfyrwyr yn dod i arfer â gwahanol becynnau o feddalwedd ar gyfer coladu, dadansoddi a chynrychioli data. Bydd disgwyl iddynt gadw llyfrau labordy taclus a cynhwysfawr, ac i ysgrifennu adroddiadau eglur o'u harbrofion. Bydd y myfyrwyr hefyd yn cael profiad o weithio mewn amgylchedd tîm (neu grp) ar brosiect pum wythnos.

Module Content: Mae'r canlynol yn rhai enghreifftiau o'r arbrofion i'w gwneud:-

Cyseiniant sbin electron, Mesuriad Franck-Hertz, Mesuriad o gludedd, Cyfres Balmer Hydrogen, Graddnodi sbectromedr gan ddefnyddio dull Edser Butler, Deddf Hubble, Dwysedd cyflyrau, Dadansoddiad rhifol, Arbrofion diffreithiant optegol, e/m electron, Yr effaith Hall, Cromlin B-H.

Mae prosiectau grp diweddar wedi cynnwys:

Canfod pelydrau cosmig, Sbectrosgopeg pelydrau gama, Deuodau allyrru golau, Ffiseg niwtrino, Ymasiad niwclear, Technolegau Cwantwm, Yr LHC, Ffiseg dan deg-punt a Adlewyrchiad mewnol cyflawn.

Intended Learning Outcomes: 1. Datblygu profiad pellach mewn cynhwysiaeth dechnegol ac echdynnu gwybodaeth bwysig a roddir o fewn y sgriptiau labordy.
2. Profiad pellach wrth gynnal arbrofion mwy datblygedig gan gynnwys cadw dyddiadur labordy (cofnod) a dadansoddiad llawn o'r canlyniadau.
3. Ymarfer ysgrifennu adroddiadau o ansawdd uchel a chydymffurfio â chanllawiau a therfynau amser anhyblyg.
4. Dealltwriaeth well o ffiseg yn deilio o berfformio arbrofion ymarferol.
5. Profiad o weithio a threfniadaeth mewn tîm/grp.
6. Profiad o'r cyflwyniad llafar gan adroddiad unigolyn o gydrannau allweddol prosiect fel rhan o gyflwyniad tîm.

Assessment: all (100%)
Resit Assessment: Coursework reassessment instrument (100%)

Assessment Description: Ymarferol mewn labordy

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Caiff asesiad ei gynnal drwy gyfrwng brofion paratoad cyn-arbrofol (PEP) ar-lein sy'n cynhyrchu adborth awtomatig, ond sydd wedi'u targedu yn seiliedig ar ganlyniadau'r prawf. Caiff dyddiaduron labordy eu hasesu a'u graddio gydag adborth manwl a ysgrifennwyd y tu mewn i'r dyddiadur labordy. Mae adroddiadau'n ffurfio rhan o'r asesiad ac yn cael eu dychwelyd gyda thaflen marcio fanwl i roi adborth personol trwy ddadansoddiad o agweddau allweddol yr adroddiad. Caiff cyflwyniadau llafar eu graddio gydag adborth personol ar gael o oruchwylwyr y prosiect.

Failure Redemption: Darparu gwaith cwrs ychwanegol.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Dim ar gael i fyfyrwyr cyfnewidiol

PH-216 Professional Development and Career Planning

Credits: 0 **Session:** 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Mr N Clarke, Miss VV Wislocka

Format: 6 hours consisting of a mix of podcasts, recorded lectures and Zoom sessions and optional 1-2-1 meetings and weekly drop-in sessions. Prior to the change it was 6 hours of face to face delivery via PC labs, and a 1-2-1 meeting where applicable / requested.

Delivery Method: This module is delivered through online resources, scheduled Zoom sessions and 1-2-1 meetings. There is self-directed learning required using online resources provided.

Module Aims: This module is optionally available for all Physics students but it is mandatory for all students who have enrolled (or transferred) onto the Physics with a Year in Industry programme. All students will benefit from taking this module.

The module focuses on the underpinning and fundamental requisites required to gain, enter and progress through a successful career. Learners will be introduced to,

(a) sourcing placements, CV writing, and application techniques;
(b) Interview techniques, how to pitch yourself and be successful;
(c) workplace fundamentals and IP awareness, behaviors and expectations; and,
(d) Key employability skills; getting the most from your job or Industrial Placement.

Module Content: The module will focus on the key requirements to gain and be successful whilst on a placement. Directed and self -directed activity will address the following topics:

1) Science Industrial Placements - What they are, how to search and how to apply.

2) CV writing, cover letters and application processes.

3) Assessment centres, interview techniques and a mock interview.

4) Recognizing and developing employability skills.

5) reflecting and maximising your placement experience.

6) one to one meeting with careers and employability officers.

Intended Learning Outcomes: By the end of this module, students will be able to:

1) Be aware of and possess the essential skills needed to secure placement opportunities; alongside having the skills to apply for relevant jobs and placements.

2) Have a general understanding of an interview process and what tools and attributes make a good interview.

3) Discuss and share what is expected within the workplace including behavioral and professional conduct.

4) Identify personal employability skills and how these will be used in a workplace setting.

5) Understand the need to reflect and maximise the placement experience in future career decisions.

Assessment: Other (100%)

Assessment Description: Students are required to attend all taught sessions and the one to one meeting (if required). These modules have no credit attached. However to ensure engagement with the content a compulsory MCQ quiz will be added in session 5. Students who do not attend and have no valid reason will not be permitted to continue on a Science Industrial Placement Year programme of study.

Moderation approach to main assessment: Not applicable

Assessment Feedback: N/A

However feedback on progress and the progression through the module will be provided in the one to one mandatory meeting and the MCQ quiz.

Failure Redemption: Successful completion of this module depends upon satisfactory attendance at, and engagement with, all sessions. Therefore there will normally be no opportunity to redeem failure. However, special provision will be made for students with extenuating or special circumstances.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online.

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PH-221 Electromagnetism and Special Relativity I

Credits: 10 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof C Nunez

Format: 22 lectures, 3 feedback sessions

Delivery Method: Lectures and feedback sessions.

Module Aims: The student will learn basics of Quantum Mechanics. Basically, the infinite square well, some problems with simple potentials and solving the Scroedinger equation.

Then the oscillator is studied, using the perspective of creation and anhilatation operators, so useful in Quantum Field Theory.
Finally, basics of the angular momentum in Quantum Mechanics is covered.

The module has a view on simple calculable problems, the effect of measurement and the idea of a complete basis of states, ideas that repeat themselves in all the cases above mentioned.

Module Content: 1. Fundamental postulates of special relativity; Lorentz transformations.
2. Measurements of space and time: simultaneity, time dilation, length contraction, twin paradox.
3. Minkowski spacetime: 4-vectors and Lorentz transformations.
4. Relativistic dynamics: 4-velocity, 4-momentum, energy-momentum relation and mass.
5. Scattering and Collisions: relativistic scattering and decays, conservation of 4-momentum; high-energy accelerators and collisions.
6. Electromagnetism: Lorentz transformation of electric and magnetic fields, field tensor, covariant form of Maxwell's equations.
7. Maxwell equations in vacuum; Lorentz invariance of electromagnetism; covariant form of Maxwell's equations.

Intended Learning Outcomes: At the end of this module, the students should:

have developed a thorough understanding of the principles of special relativity;
be able to apply relativistic dynamics in particle physics and other branches of physics;
have a clear appreciation of the relation of special relativity and electromagnetism.

Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.

Students will be able to demonstrate that they have mastered the content of the module by being able to define and summarize important terms and concepts, recall key formulae without the aid of text books or other sources.

Assessment: Examination 1 (70%)
Coursework 1 (30%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination (70%): 2 hour written exam.
Continuous Assessment (30%): 2 pieces of coursework

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

PH-222 Electromagnetism II

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr WB Perkins

Format: 22 lectures, 3 feedback sessions

Delivery Method: Lectures and feedback sessions.

Module Aims: This is an advanced module in electromagnetism, starting from Maxwell’s equations and introducing classical field theory.

Module Content: 1. Maxwell's equations in vector-differential form; equivalent integral forms and relation to known laws of electromagnetism - Gauss's law, Ampere's law, Faraday's law; electric and magnetic potentials.
2. Electrostatics: Poisson's equation and simple boundary value problems in electrostatics.
3. Electromagnetic waves: energy and the Poynting vector, polarisation, dipole radiation.
4. Maxwell's equations in media: displacement current D and magnetic field strength H; electromagnetic properties of materials; theory of magnetism.
5. Classical field theory: Lagrangian, action, equations of motion for classical fields; Lagrangian derivation of Maxwell's equations and the action for electromagnetism.

Intended Learning Outcomes: At the end of this module, the students should:

have a thorough understanding of Maxwell's equations as the basis of electromagnetism;
be able to apply Maxwell's equations to a wide range of electromagnetic phenomena, including electromagnetism in media and electromagnetic radiation;
have an appreciation of basic ideas in classical field theory.

Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.

Students will be able to demonstrate that they have mastered the content of the module by being able to define and summarize important terms and concepts, recall key formulae without the aid of text books or other sources.

Assessment: Coursework 1 (30%)
Examination 1 (70%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination (70%): 3 hour written exam.
Continuous Assessment (30%): 2 pieces of coursework

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

PH-227 Mathematical Methods in Physics II

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof DC Dunbar

Format: 22 lectures, 3 feedback sessions

Delivery Method: Lectures and feedback sessions.

Module Aims: This module introduces further mathematical methods used in Physics, especially complex variable theory, Fourier analysis, and their applications.

Module Content: 1. a Fourier Series
b applications: Mechanics, Heat
c applications: Phonons, Kaluza Klein Theory
2. a Fourier Transform
b applications: Quantum Mechanics
c applications: Optics
3. Complex Function theory:
complex algebra; poles, cuts and analyticity;
complex integration
4. A topic in Mathematical Physics

Intended Learning Outcomes: At the end of this module, the students should:

be competent in the use of complex variables in physical problems.
have a clear understanding of the power of Fourier analysis and Fourier transforms.
understand the physical implications of the existence of dual descriptions.

Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.

Students will be able to demonstrate that they have mastered the content of the module by being able to define and summarize important terms and concepts, recall key formulae without the aid of text books or other sources.

Assessment: Coursework 1 (30%)
Examination 1 (70%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination (70%): 2 hour written exam.
Continuous Assessment (30%): 2 pieces of coursework

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

PH-229 Particle Physics I

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr EI Zavala Carrasco

Format: 22 lectures, 3 feedback sessions

Delivery Method: Lectures and feedback sessions.

Module Aims: This module provides a first introduction to elementary particle physics.

Module Content: 1. Introduction to Particle Physics:
Standard Model particles, leptons, quarks, gauge bosons, Feynman diagrams, natural units, relativistic kinematics, virtual particles, Klein-Gordan equation, antiparticles, ranges of forces, Compton scattering, Mandelstam variables

2. Forces of Nature:
Electromagnetic interactions, Strong force, Weak interaction, quantum numbers

3. Quarks, Hadrons and Colour:
electron-positron annihilation, elastic and inelastic electron-proton scattering, Bjorken scaling

4. Experimental Methods:
Linear accelerators and cyclotrons, fixed target and colliding beams, the LHC
Particle dectectors: cloud and buble chambers, calorimeters, scintillation counters, spectrometers, the LHC detectors

5. Open Question:
neutrino masses and oscillations, Higgs boson, matter-anti-matter asymmetry, dark matter, dark energy

Intended Learning Outcomes: At the end of this module, the students should:

be able to apply relativistic dynamics to particle reactions at contemporary accelerators;
have a good knowledge of the elementary particles of nature;
understand the role of symmetries in the fundamental laws of nature;
have a detailed knowledge of the physics of particle accelerators and detectors and be aware of the major particle physics laboratories operating in the world today.

Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.

Students will be able to demonstrate that they have mastered the content of the module by being able to define and summarize important terms and concepts, recall key formulae without the aid of text books or other sources.

Assessment: Coursework 1 (30%)
Examination 1 (70%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination (70%):2 hour written exam.
Continuous Assessment (30%): 2 pieces of coursework

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

PH-320 Foundations of Astrophysics

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof SP Kumar

Format: 22 lectures, 3 feedback sessions

Delivery Method: Module delivery will be in person.

Module Aims: This module will introduce students to the quantitative physics underlying the formation, evolution and eventual demise of stars. Students will learn how fundamental concepts from diverse areas of physics, such as gravity, thermodynamics, statistical physics and quantum mechanics come together to provide a complete mathematical model of stellar dynamics which is in beautiful and comprehensive agreement with observational data.

Module Content: 1. Basic stellar parameters and their observed values: Mass, luminosity, radius and typical values; Blackbody relation between luminosity and temperature, Hertzsprung-Russell diagram, etc.
2. Hydrostatic equilibrium: Condition for equilibrium between gravity and pressure, Virial theorem, bounds and estimates for stellar temperatures, pressures, etc.
3. Radiative transport: Relation between luminosity, temperature gradients, mean free path and energy production rates; equations of state.
4. Nuclear processes: Energy production by fusion, quantum tunnelling, Fusion chain reactions, etc.
5. Complete Stellar life-cycle: Charting quantitatively and qualitatively the formation of a star, evolution through Main-Sequence, Red Giant, White Dwarf/Supernova phases; Exact description of degenerate Fermi gases and White Dwarfs/Neutron Stars.

Intended Learning Outcomes: Knowledge of basic observed properties of stars.
Ability to construct a mathematical model of a gravitating matter distribution in equilibrium.
Ability to infer scaling relations and estimates from the stellar model.
Knowledge of stellar evolution, the role of equilibrium thermodynamical constraints, equations of state, and inputs from quantum mechanics and nuclear physics.
Students will be able to perform calculations and solve problems based on the content of this module taking the form of analytical and/or numerical calculations without the use of text books or other sources.
Students will be able to demonstrate that they have mastered the content of the module by being able to define and summarize important terms and concepts, recall key mathematical relations and derivations without the aid of text books or other sources.

Assessment: Coursework 1 (30%)
Examination 1 (70%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination (70%): 2 hour written exam.
Continuous Assessment (30%): 2 pieces of coursework

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Students receive assessed work back with the point of error indicated.
Students have a feedback session to go through solutions to the problems.
Students can arrange with lecturer to have personal feedback on their assessments.

Failure Redemption: Re-sit if applicable.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.