

PHYSICS

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Physics involves understanding the basic principles by which all things in the universe exist and operate, and is the foundation of other scientific disciplines. It is also the natural basis of all the technology disciplines such as electronics, engineering and computer science, which were pioneered by physicists.

CONTACTS FOR PHYSICS

Physics is administered by the School of Engineering.

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| School Administrators Mary Dalbeth / Janine Williams | Room: EG.04 Phone: 07 838 4266 / 07 838 4026 Email: physics@waikato.ac.nz |
| Enrolment Contact Person Associate Professor Alistair Steyn-Ross | Room: DE2.01 Phone: 07 838 4340 Email: asr@waikato.ac.nz |

Degrees

Physics is available as a major subject for the Bachelor of Science or Bachelor of Science (Technology) degrees. The Faculty offers papers at all levels of study from pre-degree and undergraduate degrees through to postgraduate and doctoral studies.

Physics Major

General Structure of a Physics Major for the BSc and BSc(Tech) degrees

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|------------------|----------------------|--|--|--|---|
| 100 LEVEL | ENEL111 15 points | PHYS103 15 points | MATH101 15 points | 100 Level – Prerequisites: ENEL111 Introduction to Electronics, PHYS103 Physics for Scientists and Engineers, MATH101 Introduction to Calculus. | |
| 200 LEVEL | PHYS204 20 points | PHYS206 10 points ENEL284 10 points | PHYS205 10 points ENEL285 10 points | | 200 Level – PHYS204 Experimental Physics and Instrumentation, PHYS205 Statistical and Thermal Physics, PHYS206 Relativity, Nuclear and Astrophysics, ENEL284 Electricity and Magnetism, ENEL285 Quantum and Solid State Physics. |
| 300 LEVEL | PHYS301 20 points | * | * | | |

Specialisations

Students may undertake the following specialisations for the BSc and BSc(Tech) major in Physics.

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|--------------------------------|----------|
| » Agribusiness | * |
| » Science International | page 157 |
| » Te Pūtaiao me ngā take Māori | page 162 |

**Enrolment in this specialisation should be completed in consultation with both the Faculty of Science & Engineering and the Waikato Management School.*

Choosing Papers

Entry into Physics Papers

The normal entry level into physics papers is 14 credits in the NCEA at Level 3 in physics. The minimum entry level is 14 credits in the NCEA at Level 2 in either physics or mathematics. Alternatively, you can also enrol in one of the bridging physics papers. Information on bridging options may be found in the Other Programmes section (page 19).

In some cases, we are able to relax the rules relating to prerequisites. If you would particularly like to take a paper for which you have not satisfied a specified requirement, please come and talk to the staff in the school.

Physics Major

100 Level – Papers are worth 15 points.

Prerequisites

- » ENEL111A – Introduction to Electronics
- » PHYS103B – Physics for Scientists and Engineers 1
- » MATH101A/B/C/D – Introduction to Calculus
- » MATH102A/B/C/D – Introduction to Algebra

PHYS100 Exploring Physics is recommended for students lacking a strong secondary school background in physics.

Physics majors depend strongly on mathematics. You should plan to include the papers MATH101 Introduction to Calculus, and MATH102 Introduction to Algebra in your programme of study. If you lack the required NCEA pass in mathematics to attempt these papers, you may be eligible to enrol in MATH168 Preparatory Mathematics, or MATH165 General Mathematics. For further advice please contact the faculty registrar.

200 Level – Papers are worth 20 points unless specified.

Students majoring in Physics need to complete at least 60 points at 200 Level Physics, as well as several 200 Level mathematics papers.

Compulsory papers

- » PHYS204A – Experimental Physics and Instrumentation
- » PHYS205A – Relativity, Nuclear and Astrophysics (10 points)*
- » PHYS206B – Statistical and Thermal Physics (10 points)*
- » ENEL284B – Electricity and Magnetism (10 points)
- » ENEL285A – Quantum and Solid State Physics (10 points)

***Note(s):** *Second year students should include the mathematics corequisites MATH251, MATH253 and MATH255 in their programme.*

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300 Level – Papers are worth 20 points unless specified.

Compulsory paper

» PHYS301B – Biophysics

*Choose 40 points from 300 Level Physics or Electronics (ENEL) papers. Recommended:

» PHYS302B – Quantum Physics

» PHYS315A – Computational Biophysics

» ENEL312A – Electromagnetic Waves

» ENEL317B – Microprocessor Applications and Control

» ENEL321B – Application Specific Integrated Circuits

» ENEL324A – Optoelectronics

» ENEL382B – High Speed Communications*

» ENEL385B – Power Electronics

***Note(s):** *Students who select this paper should include the corequisite paper ENEL324 in their programme.*

Other papers needed to complete the degree requirements of the BSc and BSc(Tech) may come from physics, other science subjects or papers from other faculties/schools of studies.

Students not intending to major in Physics

If you are not majoring in physics, feel free to sample from our paper offerings. Generally, it will be easiest for you to pick up physics papers at 100 and 200 Level because these papers will be less affected by prerequisites.

Timetable Clashes

Your selection of papers may depend on your timetable. You will not usually be permitted to take papers that have lecture clashes. Laboratory clashes can usually be resolved. You should initially contact the relevant department if you have a laboratory clash.

Physics Papers

100 Level Papers

ENEL111-12A (HAM) – Introduction to Electronics

15 Points

This paper is recommended for all Physics majors. *For details refer to Electronics ENEL111.*

PHYS100-12A (HAM) – Exploring Physics

15 Points

This introductory paper requires only a basic knowledge of school mathematics or physics. This paper is of interest and importance to scientists, technologists, mathematicians, engineers and teachers in all disciplines who want to understand the laws and processes that govern the world around us. Students who successfully complete this paper can also take PHYS103.

Lecturer(s): *Dr Michael Cree*

Prerequisite(s): *14 credits at Level 2 NCEA in one of Mathematics or Physics, or 4 or less in Sixth Form certificate in Mathematics or Physics, or a minimum of 8 credits at Level 3 in NCEA across Statistics and Modelling and/or Mathematics with Calculus and/or Physics*

Required book(s): *Kirkpatrick and Francis **Physics: A Conceptual World View (7th ed)** with Problem Solving Supplement (Brooks/Cole) 2010*

Assessment: *Internal assessment/examination ratio: 1 : 1*

PHYS103-12B (HAM) & 12B (SEC) – Physics for Scientists and Engineers 1*15 Points*

An introduction to physics suitable for scientists and engineers. Applications of physics to the real world will be emphasised. Topics include mechanics, dynamics, oscillations, waves, sound, light, and electric and magnetic forces. This paper includes a compulsory laboratory component, and a compulsory online assignment component.

Lecturer(s): Associate Professor Alistair Steyn-Ross and Dr Howell Round

Prerequisite(s): PHYS100 or 14 credits at Level 3 NCEA in physics, or a pass in Bursary physics. Students are recommended to also enrol in MATH101 Introduction to Calculus and MATH102 Introduction to Algebra

Required book(s): Wolfson Essential University Physics Vols 1 and 2 (Pearson Addison-Wesley) 2003 with a 'Mastering Physics' online student access code

Assessment: Internal assessment/examination ratio: 1 : 1

200 Level Papers**ENEL205-12B (HAM) – Analog Electronics and Circuit Analysis***20 Points*

For details refer to Electronics ENEL205.

ENEL211-12A (HAM) – Digital Electronics*20 Points*

For details refer to Electronics ENEL211.

ENEL284-12B (HAM) – Electricity and Magnetism*10 Points*

For details refer to Electronics ENEL284.

ENEL285-12A (HAM) – Quantum and Solid State Physics*10 Points*

For details refer to Electronics ENEL285.

PHYS204-12B (HAM) – Experimental Physics*20 Points*

A laboratory based paper with emphasis on developing experimental techniques, measurement skills, analysis and organisation of results. Experiments cover measurement of fundamental constants, scientific and industrial applications and use of physical devices and instruments.

Lecturer(s): Dr Marcus Wilson

Prerequisite(s): PHYS103

Recommended book(s): Kirkup Experimental Methods (Wiley) 1994 and Squires Practical Physics, 4th ed (Cambridge) 2001

Assessment: Internal assessment/examination ratio: 1 : 0

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PHYS205-12A (HAM) – Relativity, Nuclear and Astrophysics

10 Points

This paper covers special and general relativity, nuclear physics and elementary astrophysics and cosmology.

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| Co-ordinator(s): | Professor Moira Steyn-Ross |
| Prerequisite(s): | MATH101 and one 100 level Physics paper, or 24 credits at Level 3 in NCEA physics and mathematics with calculus, or equivalent. |
| Corequisite(s): | ENEL285, MATH251, MATH253, MATH255 |
| Restriction(s): | ENEL281, PHYS202, PHYS304 |
| Required book(s): | Krane Modern Physics , 2nd ed (Wiley). |
| Assessment: | Internal assessment/examination ratio: 1 : 2 |

PHYS206-12B (HAM) – Statistical and Thermal Physics

10 Points

This paper covers topics such as temperature, thermodynamics and thermal properties of matter.

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| Co-ordinator(s): | Dr Michael Cree |
| Prerequisite(s): | MATH101 and PHYS103 |
| Corequisite(s): | MATH251, MATH253 and 20 further points at 200 level in mathematics |
| Required book(s): | Carter Classical and Statistical Thermodynamics (Prentice-Hall) 2001 |
| Assessment: | Internal assessment/examination ratio: 1 : 2 |

300 Level Papers

ENEL312-12A (HAM) – Electromagnetic Waves

20 Points

For details refer to *Electronics ENEL312*.

ENEL324-12A (HAM) – Optoelectronics

20 Points

For details refer to *Electronics ENEL324*.

PHYS301-12B (HAM) – Biophysics

20 Points

This lecture and laboratory course focuses on selected topics from biophysics, including: cell electrophysiology, ionising radiation, radiobiology and radioprotection, physics of the senses, detection of electrophysiological signals, imaging, interaction of electric fields with cells, cortical modelling. It contains a necessary experimental component that will introduce students to data acquisition, analysis relevant to biophysics and medical imaging. This course is compulsory for all students who wish to major in physics.

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| Co-ordinator(s): | Dr Marcus Wilson |
| Prerequisite(s): | PHYS201 (or both PHYS206 and ENEL284) and, PHYS202 (or both PHYS205 and ENEL285) |
| Assessment: | Internal assessment/examination ratio: 2 : 3 |

PHYS302-12B (HAM) – Quantum Physics*20 Points*

This paper covers classical Lagrangian theory, Hamilton's equations, basic postulates of quantum mechanics, representations, Dirac notion, angular momentum, perturbation theory, conceptual problems and solid state theory.

Lecturer(s): Professor Moira Steyn-Ross and Dr Michael Cree

Prerequisite(s): Either PHYS202, or both PHYS206 and ENEL285

Assessment: Internal assessment/examination ratio: 1 : 2

PHYS315-12A (HAM) – Computational Biophysics*20 Points*

This is a lecture and computer laboratory paper on computational methods used in neuroscience and biophysics. Topics covered include linear and non-linear differential equations, Euler and Runge-Kutta integration methods, limit cycles, action potential generation, hysteresis and memory in simple neural systems stability and stochastic resonance, random numbers and noise simulation, root finding, and curve fitting. The programming language used is MATLAB.

Lecturer(s): Associate Professor Alistair Steyn-Ross

Prerequisite(s): PHYS103 and any two of MATH251, MATH253, MATH255, ENGG283, ENGG284, ENGG285, and ENGG287

Restriction(s): PHYS516

Required book(s): Wilson *Spikes, Decisions, and Actions* (Oxford University Press) 1999

Recommended book(s): The Student Edition of *MATLAB Student User Guide* latest edition (Prentice-Hall)

Assessment: Internal assessment/examination ratio: 1 : 0

PHYS318-12A/B/C/Y (HAM) – Special Topics in Physics*20 Points*

A library research paper and/or experimental project in selected topics in physics, supervised on a tutorial basis and examined by written reports and/or experimental exercises.

Co-ordinator(s): Dr Marcus Wilson

Corequisite(s): As appropriate to topic.

Assessment: Internal assessment/examination ratio: 1 : 0

Note(s): Available on invitation only

BSc(Tech) Work Placement Papers

For details refer to Work Placements.