School of Chemical and Physical Sciences

PHYSICS & SPACE SCIENCE UNDERGRADUATE COURSES

›› 2026

Contact

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PHYSICS

Physics is about understanding nature at its most fundamental, from elementary particles to complex materials, from the kinetic energy of a speeding missile to the nuclear energy released in the core of a star. The concepts of physics – the effect of a force for example – apply to multitudes of different situations, in all imaginable contexts: mechanical, electrical, magnetic, astronomical, chemical, geological, biological… the list goes on forever. Physics is one of the foundations on which other branches of science are built. An understanding of the principles of physics is essential to applied disciplines such as engineering, architecture, environmental studies, medicine and information technology.

MAJOR REQUIREMENTS FOR PHYSICS

1. (MATH142, 151) or (ENGR121 and B+ or better in ENGR122), PHYS142, 145
2. PHYS241, PHYS242; one of (PHYS243, PHYS245); 15 further points from (EEEN201–204, PHYS201–259, CHEM205 - 206); 15 further points from (MATH200-299, NWEN241, STAT292, COMP261)
3. PHYS304, PHYS305, PHYS307, PHYS345.

ENTRY TO 100-LEVEL PHYSICS COURSES

- Automatic entry to PHYS145 and PHYS101 with 16 achievement standard credits of NCEA Level 3 Mathematics (or equivalent) or MATH132
- Automatic entry to PHYS142 with PHYS101 or (MATH141 or approved level of achievement in NCEA Level 3 Calculus[1] and (PHYS131 or physics standard AS 91524 "mechanical systems" with excellence).
- **A Level:** a minimum of D at A level or A at AS level (or better) in both Physics and Mathematics in the A level Cambridge International Examinations.; or
- **International Baccalaureate:** a minimum of 4 at HL or 6 at SL (or better) in the IB grade scale in both Physics and Mathematics.
- If you have studied physics and maths at school, but you don't meet the requirements for automatic entry, or you have other qualifications (e.g. from overseas schooling, or other tertiary education institutions), then you may still qualify. Please contact the Programme Director as early as possible, giving full details of your qualifications.
- Intermediary level physics and maths courses, PHYS131, PHYS101, MATH132, MATH141 provide alternative routes to PHYS142 and PHYS145
- Students who have achieved excellent high school and/or scholarship results across a broad range of physics and mathematics topics may be eligible for acceleration to one or more 200-level physics courses in their first year of study. Students interested in exploring this option should contact the Programme Director in mid-February or as soon as their results become available.

WHO TO CONTACT

All enquiries about undergraduate Physics courses should be directed to the Programme Director, Prof Franck Natali (franck.natali@vuw.ac.nz).

[1] This includes the following NCEA Level 3 achievement standards:
- 3.6 (Differentiation, AS91578) achieved with Excellence
- 3.7 (Integration, AS91579), and
- one of 3.1 (Conics, AS91573), 3.3 (Trigonometry, AS91575), or 3.5 (Complex numbers, AS91577).

You need a Merit or Excellence grade in at least one of 3.1, 3.3, 3.5, or 3.7.

SPACE SCIENCE

Space technologies such as satellites help us to understand our place in the universe. They support GPS trackers in our navigation apps, give up-to-the-minute weather information, make modern broadcasting possible, and allow us to explore the far recesses of the universe. Our Space Science major gives a broad view of the space industry—from the technical innovations needed to go into space to the ethical and legal issues that develop as we push out of Earth's orbit. In our Space Science major, you'll focus on the practical aspects of space, and courses also delve into the history of astronomy and space exploration, alongside perspectives on the night sky in Māori and Pasifika culture. You'll gain skills in computer science and maths, and graduate ready to launch your career in the space sector.

MAJOR REQUIREMENTS FOR SPACE SCIENCE

1. SPCE101, SPCE102; one of (MATH132, 141, 142, ENGR121, QUAN111); one of (COMP102, 112, 132)
2. SPCE201; one of (SPCE245, PHYS245); DATA201; GEOG215
3. SPCE301, SPCE345, GEOG315; one of (SCIS311, ESCI305, SPCE360)

ENTRY TO 100-LEVEL SPACE SCIENCE COURSES

Standard University Entrance requirements.

WHO TO CONTACT

All enquiries about Space Science courses should be directed to the Programme Director, Dr Tulasi Parashar (tulasi.parashar@vuw.ac.nz).

100-LEVEL COURSES

PHYS 101	CRN 35064	Introduction to Physics	15 PTS	1

Prerequisites: (16 Achievement Standard credits NCEA Level 3 Mathematics) or (12 Achievement Standard credits NCEA Level 3 Mathematics excluding the statistics standards 91580, 91581, 91582, 91583, 91584) or MATH132;

Restrictions: PHYS114, PHYS115, ENGR141;

PHYS101 is designed for students who want a university level introduction to physics. It will serve students majoring in physics without requiring prior knowledge in physics. The course will also serve any (science or otherwise) student, interested in general ideas of physics as a way of understanding the (physical) world around us. The course introduces basic concepts as well as worked examples. Exercises and assignments will reinforce key concepts. Topics covered are: - mechanics (energy, Newton's laws, gravity) – waves – thermodynamics and required math concepts (limits, derivatives, functions).

PHYS 145	CRN 35066	Practical Skills for Scientists: Applications in Physics	15 PTS	1

Prerequisites: (16 Achievement Standard credits NCEA Level 3 Mathematics) or (12 Achievement Standard credits NCEA Level 3 Mathematics excluding the statistics standards 91580, 91581, 91582, 91583, 91584) or MATH132;

Restrictions: PHYS114, 115

PHYS145 is designed to teach basic computing, data analysis, physics, and mathematics transferrable skills and their applications to practical physics problems. It will serve students majoring in physics and is also open to any (science or otherwise) student, interested in a hands-on experience of physics. The course will introduce skills required for experimental physics in laboratory environments and use them to explore physics phenomena in optics, mechanics, modern physics and thermodynamics.

SPCE 101	CRN 35040	Introduction to Space Science	15 PTS	1

Prerequisites: *none*

Restrictions: *none*

This course introduces space science and its applications. From the space race through to the effects of inter-planetary space travel on future astronauts, and the historic significance of the heavens to humankind in Aotearoa and globally. Introductory and accessible physics, astronomy, problem-solving and discussion aid the student's learning experience in this course, and into the rest of the Space Science programme.

ENGR 141	CRN 30094	Engineering Science	15 PTS	1

Prerequisites: (16 Achievement Standard credits NCEA Level 3 Mathematics) or (12 Achievement Standard credits NCEA Level 3 Mathematics excluding the statistics standards 91580, 91581, 91582, 91583, 91584) or MATH132

Restrictions: PHYS101, PHYS114, PHYS115

ENGR141 deals with scientific topics relevant to Engineering. Topics will include forms and use of energy, Newton's laws of motion, gravity, waves, thermodynamics and required math concepts (limits, derivatives, functions). Students will obtain an appreciation for quantitative scientific reasoning and the role of fundamental physical laws in governing human energy use.

PHYS 142	CRN 35065	Calculus-based Physics	15 PTS	2

Prerequisites: PHYS101 or ((MATH141 or approved level of achievement in NCEA Level 3 Calculus1) and (PHYS131 or physics standard AS 91524 "Mechanical Systems with Excellence));

Restrictions: ENGR142, PHYS114, 115

PHYS142 covers topics in electrostatics and will also cover mechanics (circular and harmonic motion) and required math concepts (differential equations and integration).

SPCE 102	CRN 35041	Introduction to the Universe	15 PTS	2

Prerequisites: *none*

Restrictions: PHYS132

An introduction to astronomy and astrophysics for students from all backgrounds. We will explore objects from the relatively small and nearby, in our Solar System, to the largest and most distant objects in the Universe: galaxies and galaxy clusters. You will learn about the Big Bang origin and evolution of the expanding Universe, and along the way be introduced to some of the most extreme places and phenomena known - neutron stars, black holes and supernovae. Coming back down to Earth, you will discuss dark skies, Māori astronomy, and waka navigation.

200-LEVEL COURSES

PHYS 243	CRN 33242	Classical Mechanics and Relativity	15 PTS	1

Prerequisites: (MATH142, 151) or B+ or better in ENGR122; one of (PHYS101, 114, 142, ENGR141);

Restrictions: PHYS221, 223; either of PHYS260, 261 as determined by the head of school

An introduction to classical mechanics and relativity at an intermediate level, including Lagrangian mechanics, Hamiltonian mechanics, special relativity and a conceptual introduction to general relativity.

PHYS 245	CRN 33243	Methods of Experimental Physics	15 PTS	1

Prerequisites: (MATH142 (or B+ or better in MATH141), MATH151) or B+ or better in ENGR122; (PHYS114, 115) or (PHYS145) or (ENGR141, 142);

Restrictions: PHYS217; either of PHYS260, 261 as determined by the head of school

PHYS245 will focus on skills required for experimental physics in laboratory environments. This will include planning of experimental designs and the processing, interpretation, documentation and presentation of experimental results. The course will also introduce basic concepts of programming and numerical physics.

SPCE 245	CRN 36017	Experiments in Space Science	15 PTS	1

Prerequisites: one of (SPCE101, 102, PHYS132); one of (COMP102, 112, 132)

Restrictions: *none*

Through hands-on experimentation you will explore physical phenomena relevant to space exploration and usage. This includes topics such as seeing how light and high-energy radiation interact with matter, how rockets deplete their fuel reserves, or analysing data from meteors entering the Earth's atmosphere. With guest lectures and projects you will also learn some of the rich cultural associations that Māori and Pasifika people have with the night sky. This course will help you develop transferrable skills in scientific writing and presentation, in the exciting context of space.

PHYS 241	CRN 33240	Quantum Mechanics and Kinetic Theory	15 PTS	2

Prerequisites: (MATH142, 151) or B+ or better in ENGR122; PHYS142 or 114, 115;

Restrictions: PHYS221, 223; either of PHYS260, 261 as determined by the head of school

PHYS241 will provide students with an introductory-level understanding of quantum mechanics and its applications. The course will also introduce students to the microscopic description of temperature, pressure and other properties of matter based on kinetic theory.

PHYS 242	CRN 33241	Electromagnetism I	15 PTS	2

Prerequisites: (MATH142, 151) or B+ or better in ENGR122; (PHYS142, 145) or (PHYS114, 115) or (ENGR141, 142);

Restrictions: PHYS222; either of PHYS260, 261 as determined by the head of school

PHYS242 will provide a comprehensive foundation in electromagnetic theory using vector calculus, from the laws of electrostatics and magnetostatics to the time-varying Maxwell equations. The course will also introduce applications of these concepts to electrical circuits, as well as electromagnetic waves, interference and diffraction.

SPCE 201	CRN 36016	Our Dynamic Space Neighbourhood	15 PTS	2

Prerequisites: SPCE101, one of (SPCE102, PHYS132); one of (COMP102, 112, 132)

Restrictions: *none*

The course starts with introductory orbital mechanics, rocketry, the physics of space-related heat and electromagnetic energy through to the Sun and its violent solar weather. Then, through energy transfer in the Earth's atmosphere the course explores climate change, remote sensing concepts, monitoring habitat from space and applications to preserving taonga. The course also discusses the practical and ethical issues of terraforming on Mars and possibilities for extra-terrestrial life. Discussions and readings around the unifying and divisionary social and political uses of orbiting technology aid the students to see beyond the science and technology of space.

300-LEVEL COURSES

PHYS 305	CRN 1199	Thermal and Statistical Physics	15 PTS	1

Prerequisites: PHYS241 (or 223); one of (MATH200-299, NWEN241, STAT292, COMP261);

Restrictions: either of PHYS360, 361 as determined by the head of school

A development of statistical mechanics, thermodynamics, and heat propagation. The Fermi-Dirac, Bose-Einstein, and classical distributions are derived and illustrated with examples taken from thermal radiation, heat engines, solid state physics, astrophysics, and chemical physics. Concepts of nuclear decays as probabilistic processes will be developed and applied to the early universe and thermonuclear reactions.

PHYS 307	CRN 1201	Quantum Physics	15 PTS	1

Prerequisites: PHYS241, 242 (or 221 and 222); one of (MATH200-299, NWEN241, STAT292, COMP261);

Restrictions: either of PHYS360, 361 as determined by the head of school

An advanced course on quantum mechanics based on Dirac bra-ket notation, covering the fundamentals as well as current applications.

PHYS 304	CRN 1198	Electromagnetism and Wave Optics	15 PTS	2

Prerequisites: PHYS242 (or 222 and 223); one of (MATH200-299, NWEN241, STAT292, COMP261);

Restrictions: either of PHYS360, 361 as determined by the head of school

The course presents Maxwell's theory of classical electromagnetism, with full use of vector calculus in cartesian, cylindrical and spherical coordinates. The course builds upon electric and magnetic phenomena introduced in PHYS115 and PHYS242, and includes the response of materials to static and time-varying electromagnetic fields. The derivation of electromagnetic waves and their polarisation properties is followed by modern applications such as waveguides and multilayer optics.

PHYS 345	CRN 34082	Advanced Methods of Experimental Physics	15 PTS	2

Prerequisites: 15 pts from (PHYS114, 115, 142, ENGR142) and 15 pts from (PHYS245, CHEM205-206, EEEN201-204) or (MATH243 and one of PHYS221-223);

Restrictions: either of PHYS360, 361 as determined by the head of school

PHYS345 will extend the skills and knowledge acquired at 200 level and explore experimental and numerical methods relevant to modern physics and data acquisition/analysis. Common physics laboratory equipment and computational methods (for example vacuum systems, spectrometers or software tools) will be used for more complex experimental set ups data processing. The course will extend guidance for good laboratory practice including the planning of experimental designs, data processing, interpretation, documentation and presentation of experimental results.

SPCE 301	CRN 37001	Challenges and Solutions for Space Systems	15 PTS	1

Prerequisites: SPCE201; SPCE245 or PHYS245

Restrictions: *none*

Through a mock mission design project, learn the challenges and solutions involved in space mission design. You will extend your previous knowledge in the physics and engineering of orbits, heat shielding, space-based communication and more as applied to a mock mission developed collaboratively with the class. Along the way, you will learn concepts from systems engineering, mission design and testing, project management, presentation skills for both technical and non-technical audiences, and develop your confidence with computational methodology. Socio-cultural aspects of mission design will be informed by cultural and ethical issues from international as well as domestic perspectives including tikanga Māori.

SPCE 360	CRN 37003	Topics in Earth Observation and Space Science	15 PTS	1

Prerequisites: GEOG215; 15 COMP pts or INFO 102; 15 MATH pts

Restrictions: *none*

This course equips you with the fundamental skills and knowledge required to extract meaningful information from Earth observation data. You will learn data acquisition, processing, interpretation, and analysis using a project-based approach. Topics covered include image classification, spectral analysis, and change detection among others.

SPCE 345	CRN 37002	Advanced Experiments in Space Science	15 PTS	2

Prerequisites: SPCE245 or PHYS245

Restrictions: *none*

In this course you will advance the experimental methodologies learnt in SPCE245. Through formal teaching and hands-on project work you will develop skills in data analysis, visualization, technical and scientific presentation. You will undertake a mixture of practical and software-based activities. Finally, you will complete a small-group project applying these skills to a scientific problem such as space debris tracking, predicting solar storms, orbital mechanics, image analysis or ionospheric behaviour and present your results at an end-of-year conference.