Bachelor of Applied Science (Honours) (SC60)

Year offered: 2011
Admissions: Yes
CRICOS code: 009041G
Course duration (full-time): 1 Year
Course duration (part-time): 2 Years
Domestic Fees (indicative): 2011: CSP $2,178 (indicative) per semester
International Fees (indicative): 2011: $12,375 (indicative) per semester
Domestic Entry: February and July
International Entry: February and July
Total credit points: 96
Standard credit points per full-time semester: 48
Course coordinator: Associate Professor Terry Walsh
Discipline coordinator: Dr David Hurwood (Biogeosciences majors); Dr John McMurtrie (Chemistry Major); Associate Professor Terry Walsh (Life Science Major); Dr Troy Farrell (Mathematics Major); Dr Esa Jaatinen (Physics Major)
Campus: Gardens Point

Overview
Through a combination of research and advanced coursework units, students can pursue specialised studies in a particular area of information technology. The course offers the opportunity to develop research and development skills, work on cutting-edge technology, and have access to specialist hardware and software. As a successful Honours graduate you are eligible to start a doctoral program, and can expect to obtain a research or teaching position. A wider range of career opportunities are available.

Course Design
The core of the honours program is a 36, 48, or 60 credit-point project (depending on your study area) that will provide students with the opportunity to learn about research by conducting a research project with an experienced researcher who acts as both supervisor and mentor. Students will learn the types of processes, creativity and analytical thinking that lead to scientific and technological advances and how to communicate such findings in a rigorous, systematic manner.

Note:
The Faculty may wish to make your honours project or thesis work available to other students undertaking Honours studies as an exemplar. As the copyright owner of the work you have created, the Faculty will respect your rights and will seek your authorisation to share your work.

Professional Recognition

Relevant scientific professional bodies include Australasian Association of Clinical Biochemists, Australasian Institute of Mining and Metallurgy, AusBiotech Ltd, Australian Institute of Geoscientists, Australian Institute of Physics, Australian Mathematical Society, Australian Society for Biochemistry and Molecular Biology, Australian Society for Medical Research, Australian Society for Microbiology, Australian Society for Operations Research, Ecological Society of Australia, Geological Society of Australia, Royal Australian Chemical Institute, and Statistical Society of Australia. Eligibility for membership is based on the combination of units undertaken in the degree and the Bachelor of Applied Science course that underpins it.

Course Structure
The Honours year comprises coursework and a major research project supervised by QUT staff, in some cases in conjunction with local industry. Majors are offered in chemistry, ecology, environmental science, geology, life science, mathematics and physics.

Further Information
Course Coordinator
Associate Professor Peter Mather
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Discipline Coordinators
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Environmental Science
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Geology
Mr David Hurwood
Phone: +61 7 3138 5072
Email: d.hurwood@qut.edu.au

Life Science
Associate Professor Terry Walsh
Limits on grades of 3
A new policy concerning grades of 3 came into effect from 1 January 2009 (QUT MOPP C/5.2). With effect from this date grades of 3 are no longer considered a conceded or low pass but are classified as a fail grade. Any grades of 3 awarded prior to 1 January 2009 retain the conceded pass status and will be counted for graduation purposes up to the maximum number of grades of 3 permitted for your course. Grades of 3 incurred in units that commence after 1 January 2009 will not count towards your degree. Further information is available on the Student Services website.

Course structure - Major in Chemistry

Year 1, Semester 1
- PCB700-1 Research Project
- PCB700-2 Research Project
- PCB742 Elective Unit
- PCB780-1 Advanced Topics in Chemistry 1

Year 1, Semester 2
- PCB700-3 Research Project
- PCB700-4 Research Project
- PCB700-5 Research Project
- PCB780-2 Advanced Topics in Chemistry 1

NOTE: Students wishing to apply for entry into BAppSc(Hons) should consult with the contact person for the relevant science discipline before applying (see contact details link above).

Course structure - Major in Life Science

Year 1, Semester 1
- LSB850-1 Research Strategies
- LSB851-1 Readings in Life Science 1
- LSB852-1 Project

Year 1, Semester 2
- LSB850-2 Research Strategies
- LSB851-2 Readings in Life Science 1
- LSB852-2 Project

NOTE: Students wishing to apply for entry into BAppSc(Hons) should consult with the contact person for the relevant science discipline before applying (see contact details link above).

Course structure - Major in Mathematics

Year 1, Semester 1
- MAN787-1 Project
- 36 credit points of elective units selected from the list below*

Year 1, Semester 2
- MAN787-2 Project
- MAN787-3 Project
- 24 credit points of elective units selected from the list below*

Elective List (Mathematics) - 60 credit points to be selected
- MAN717 Minor Project
- MAN761 Analysis
- MAN764 Applied Mathematical Modelling
- MAN765 Bayesian Data Analysis
- MAN766 Applied Time Series Analysis
MAN768  Advanced Techniques in Operations Research
MAN769  Mathematics of Finance
MAN771  Computational Mathematics 4
MAN774  Perturbation Methods
MAN775  Statistical Modelling of Financial Processes
MAN777  Mathematics of Fluid Flow
MAN778  Applications of Discrete Mathematics

Up to 12 credit points from the following lists can be included in the 60 credit points of electives:

MAB522  Computational Mathematics 3
MAB524  Statistical Inference
MAB613  Partial Differential Equations
MAB672  Advanced Mathematical Modelling

MAN536  Time Series Analysis

Up to two units of a quantitative nature from another Faculty or School may be included with the permission of the Mathematics Coordinator. The unit(s) must be of honours level and relevant to the proposed program.

Examples of suitable units are:

EFN505  Financial Risk Management
PCB706  Quantum Mechanics

* The Course Coordinator may approve a student taking 24 credit points of elective units (together with MAN787-1 and MAN787-2) in Semester 1 and 36 credit points of elective units (together with MAN787-3) in Semester 2.

NOTE: Students wishing to apply for entry to BAppSc(Hons) should consult with the contact person for the relevant science discipline before applying (see contact details link above).

Elective List (Physics)

PCB708  Advanced Topics in Physics
PCN716  Advanced Topics in Physics 2
PQB660  Astrophysics 2
PQB661  Lasers and Photonics

NOTE: PCB708 and PCN716 typically comprise two components chosen from atmospheric aerosol physics, classical mechanics, non-linear optics, quantum electrodynamics, advanced general relativity or aspects of units from the Masters in Medical Physics course.

Potential Careers:


UNIT SYNOPSES

EFN505 FINANCIAL RISK MANAGEMENT

The unit covers the main areas of modern risk management. The focus is on measuring and managing risks in financial institutions. Particular attention is paid to developing understanding of the analytical techniques employed in the construction of hedging strategies and the interrelations between the main areas of risk management. The unit emphasises empirical applications and assessment of risk management techniques. Topics covered include the current state of prudential regulation of financial institutions, measurement and management of market risks, hedging strategies with derivatives and managing interest rate and exchange rate risks.

Prerequisites: EFN415   Equivalents: EFX505   Credit points: 12   Contact hours: 3 per week   Campus:
Acquisition of the skills and strategies for critically analysing scientific papers and for writing a competitive research proposal is a prerequisite for a successful scientific career. The aim of this unit is to provide you with the skills and strategies to examine critically the significance of scientific papers and to write a successful grant application.

**Prerequisites:** LSB850-1, LSB851-1 and LSB852-1

**Corequisites:** LSB850-2, LSB852-2  **Credit points:** 12

**Campus:** Gardens Point  **Teaching period:** 2011 SEM-1 and 2011 SEM-2

**LSB852 PROJECT**

A career in research will involve your understanding of the methods of independent scientific investigation and analysis, your ability to identify the need for a particular investigation, your skills to frame a testable hypothesis and design appropriate tests to examine it, and communication of your ideas and arguments to others. Thus, this unit builds on the knowledge you have gained in your undergraduate units, with particular emphasis on practical aspects of technique applications, data interpretation, and the presentation of a scientific argument in a coherent and acceptable format. This unit runs over two semesters (full-time) and is the core component of the SC60 BAppSc (Hons) degree, comprising the laboratory research project of the course and its reporting in written and oral formats. The aim of the unit is to provide you with the skills for independent, laboratory based investigation, analysis and reporting.

**Corequisites:** LSB850-1, LSB851-1  **Credit points:** 30

**Campus:** Gardens Point  **Teaching period:** 2011 SEM-1 and 2011 SEM-2
MAB522 COMPUTATIONAL MATHEMATICS 3
This unit includes: deriving the basic equations that describe fluid motion; the finite volume method for solving PDEs (application to the generalised diffusion equation, cell-centred and vertex-centred schemes, handling of boundary and initial conditions); solution of systems of nonlinear equations (Newton’s method, Inexact Newton methods, Globally convergent methods).
Prerequisites: MAB311 and MAB420 Antirequisites: MAN522 Credit points: 12 Contact hours: 4 per week Campus: Gardens Point Teaching period: 2011 SEM-1

MAB524 STATISTICAL INFERENCE
This unit includes: maximum likelihood estimation, confidence intervals and hypothesis tests, introduction to Bayesian inference, prior and posterior distributions, Bayesian inference for binomial data, Poisson count data and normal data, simulation techniques for sampling from distributions. Use of software Matlab and R.
Prerequisites: MAB314 Credit points: 12 Contact hours: 4 per week Campus: Gardens Point Teaching period: 2011 SEM-1

MAB613 PARTIAL DIFFERENTIAL EQUATIONS
Partial differential equations are the classical foundation of mathematical models used to unambiguously describe processes exhibiting spatial and temporal variation. There exist numerous modern important examples of such so-called continuum models and so it is essential that any practising mathematician be conversant with both the background, formulation and solution of such equations. This unit aims to develop your understanding of the construction, analysis, solution and interpretation of partial differential equation models of real-world processes.
Prerequisites: MAB311 and MAB413 Antirequisites: MAN613 Credit points: 12 Contact hours: 4 per week Campus: Gardens Point Teaching period: 2011 SEM-2

MAB672 ADVANCED MATHEMATICAL MODELLING
Models are developed beginning with the description of 'real world' problems. Emphasis is on the mathematical modelling and not on the development of new mathematical techniques. The unit includes: mathematical modelling; model formulation; dimensional analysis and re-scaling; curves of pursuit; bungy jumping; modelling with systems of ordinary differential equations; phase plane methods for analysing systems of ODEs; bacterial growth in a chemostat; predator-prey models with harvesting; limit cycles; oscillations and excitible media; modelling with partial differential equations; motion of a continuum; continuity; traffic flow; aggregation of slime mould amoebae; momentum; ideal gas dynamics; quasi-linear PDEs.
Prerequisites: MAB422 Antirequisites: MAN672 Assumed knowledge: MAB311. Also recommend:

MAB413 Credit points: 12 Contact hours: 4 per week Campus: Gardens Point Teaching period: 2011 SEM-1

MAN536 TIME SERIES ANALYSIS
Data in business, economics, engineering and the natural sciences often occur in the form of time series. Time Series Analysis provides models and methods for the analysis of such series of correlated observations. The ability to forecast optimally, to understand causal relationships between variables, and to analyse dynamic systems is of great practical importance. For example, optimal sales forecasts are needed for business planning, transfer function models are needed for improving the design and control of a process plant, and vector time series models are used to represent the relationships and interactions of macroeconomic variables in any economy.
Prerequisites: MAB314 and MAB414 Antirequisites: MAB536, MAN526 Credit points: 12 Campus: Gardens Point Teaching period: 2011 SEM-2

MAN717 MINOR PROJECT
Research in the Mathematical and Statistical Sciences can be intellectually challenging and rewarding and generally requires a knowledge base and a range of generic capabilities to be developed to a level that is not normally achieved in a bachelor degree of three years duration. This unit offers you the opportunity to acquire this knowledge and these capabilities. By undertaking a minor research project in a field which is of interest to you, undertaking advanced level coursework in a discipline related to your area of Mathematical interest, or both. Permission to enrol in this unit must be obtained from the Course Coordinator.
Other requisites: Unit coordinator approval is required to enrol Credit points: 12 Campus: Gardens Point Teaching period: 2011 SEM-1, 2011 SEM-2 and 2011 SUM

MAN761 ANALYSIS
This unit includes: convergence in R; uniform convergence; Lebesgue integral; convergence theorems; Lp-spaces; metric spaces; completeness and compactness; contraction mappings; normed and Banach spaces; dual spaces; linear operators; Hilbert spaces; Hilbert-adjoint operator; linear operator equations; spectrum of a linear operator.
Prerequisites: MAB311 and MAB312 Credit points: 12 Contact hours: 3 per week Campus: Gardens Point

MAN764 APPLIED MATHEMATICAL MODELLING
Through the investigation of case studies and the development and practice of techniques and skills related to the formulation of mathematical models and their numerical solution, this unit provides you with the opportunity to employ these skills you have developed in your studies in mathematics, combining them in a coherent manner for solving topical and relevant problems. You will become
familiar with methodologies for developing mathematically based theoretical tools for the solution of problems that may well be outside your core discipline area and in communicating the results of your theoretical study to a diverse audience.

**Prerequisites:** MAB613 and MAB672    **Credit points:** 12
**Contact hours:** 3 per week    **Campus:** Gardens Point    **Teaching period:** 2011 SEM-2

**MAN765 BAYESIAN DATA ANALYSIS**
This subject builds on the foundations of Bayesian analysis laid in MAB524 to extend modelling and computational approaches to real world problems. Skills in using statistical computing platforms for Bayesian analysis, model development and comparison, and extending computational approaches will be developed. You are encouraged to apply skills to data modelling tasks motivated by their work or research areas.

**Prerequisites:** MAB524 or MAN524    **Credit points:** 12
**Contact hours:** 3 per week    **Campus:** Gardens Point    **Teaching period:** 2011 SEM-2

**MAN766 APPLIED TIME SERIES ANALYSIS**
This unit introduces you to the modern tools of Time Series Analysis. It covers both linear and nonlinear time series models; state-space models; generalised state-space models; the Kalman recursions for filtering, prediction and smoothing; applications to business and financial time series. The unit will develop the mathematical and statistical concepts and show how these concepts are then applied in practical situations.

**Prerequisites:** (MAB524 or MAB524) and (MAN536 or MAB536)    **Credit points:** 12    **Contact hours:** 3 per week    **Campus:** Gardens Point    **Teaching period:** 2011 SEM-1

**MAN768 ADVANCED TECHNIQUES IN OPERATIONS RESEARCH**
This unit includes the following: inventory systems modelling, material requirement planning, just-in-time production; production planning and scheduling, including static and dynamic methods, aggregate planning, LP/LDR/SDR techniques; resources allocation; heuristics; operations scheduling, including sequencing and balancing techniques, job shop scheduling, assembly line balancing; NP-completeness.

**Prerequisites:** (MAN525 or MAB525) and (MAN625 or MAB625)    **Credit points:** 12    **Contact hours:** 3 per week    **Campus:** Gardens Point    **Teaching period:** 2011 SEM-1

**MAN769 MATHEMATICS OF FINANCE**
This unit will present to you the essential elements of mathematical finance including the development of stochastic calculus which is essential for a quantitative treatment of mathematical finance. Computational approaches will be developed for simulating various financial instruments. In addition, the application of models and methods developed in some key problems of mathematical finance will be demonstrated to you.

**Prerequisites:** MAN623 or MAB623 or MAN522 or MAB522    **Credit points:** 12    **Contact hours:** 3 per week    **Campus:** Gardens Point    **Teaching period:** 2011 SEM-2

**MAN771 COMPUTATIONAL MATHEMATICS 4**
An essential skill for practicing applied mathematicians and engineers is the derivation and implementation of computational models for solving the equations that govern many of the physical processes encountered in research and industry. Through the investigation of specific case studies developed in Matlab, the derivation of numerical techniques, the implementation of efficient algorithms and the visualisation of the simulation results, students undertaking this unit will develop an understanding of the value of computational mathematics. The aim of this unit is to provide you with the opportunity to employ a number of the skills that you have developed in the discipline of computational mathematics, combining them in a coherent manner for solving topical and relevant real world problems.

**Prerequisites:** (MAN622 or MAN522) and (MAB613 or MAN613)    **Credit points:** 12    **Contact hours:** 3 per week    **Campus:** Gardens Point    **Teaching period:** 2011 SEM-2

**MAN774 PERTURBATION METHODS**
This unit includes: regular and singular perturbation expansions; asymptotic expansions, strained coordinates; boundary layer analysis and matched asymptotic expansions; selected examples from industrial applications and mathematics applied in medicine and biology.

**Prerequisites:** (MAN413 or MAB413) and (MAN521 or MAB521)    **Credit points:** 12    **Contact hours:** 3 per week    **Campus:** Gardens Point    **Teaching period:** 2011 SEM-2

**MAN775 STATISTICAL MODELLING OF FINANCIAL PROCESSES**
Postgraduate students pursuing a career in finance will find that financial modelling is a major area of application of mathematics and statistics. In fact, its models and methods, which draw on recent developments in diverse areas of mathematical sciences such as stochastic analysis, partial differential equations and probability theory, provide needed tools for quantitative modelling and financial analysis. In fact, its fundamental principles enhance a general education for life. This unit is one of a suite of units in statistics and operations researchDecision Science, which will equip you with essential skills for pursuing a career in business and finance.

**Prerequisites:** MAB524 and MAN536    **Credit points:** 12    **Contact hours:** 3 per week    **Campus:** Gardens Point    **Teaching period:** 2011 SEM-2
MAN777 MATHEMATICS OF FLUID FLOW
The mathematics of fluid flow involves solving ordinary and partial differential equations arising as simplifications of the Navier-Stokes equations. Approximation techniques for flows in thin layers are also considered as well as approximations of flows of low and high viscosity. Questions addressed include: why a spinning cricket ball swerves in the air; how much does a blockage in an artery or vein increase the pressure; and why is there no solution for flow past a cylinder for zero Reynolds number.
Prerequisites: MAN613 or MAB613 Credit points: 12
Contact hours: 3 per week Campus: Gardens Point
Teaching period: 2011 SEM-1

MAN778 APPLICATIONS OF DISCRETE MATHEMATICS
This unit has two main areas of study. One is the application of graph theory to a number of practical problems including trees and shortest path algorithms. The other area is advanced number theory and includes the topics of divisibility, congruence, multiplicative functions, primitive roots, quadratic residues and applications to cryptology including the RSA algorithm.
Prerequisites: MAN461 or MAB621 Credit points: 12
Contact hours: 3 per week Campus: Gardens Point
Teaching period: 2011 SEM-1

MAN787 PROJECT
Research in the Mathematical and Statistical Sciences has contributed significantly to a vast range of social and economic amenities. Such research can be intellectually challenging and rewarding and generally requires a range of capabilities to be developed to a level that is not normally achieved in a bachelor degree of three years duration. This unit offers you the opportunity to develop and/or refine some of these capabilities by undertaking a research project that is significant in the context of the social and economic outcomes alluded to above. Permission to enrol in this unit must be obtained from the Course Coordinator.
Credit points: 12 Campus: Gardens Point Teaching period: 2011 SEM-1, 2011 SEM-2 and 2011 SUM

NRB720 PROJECT
Independent research is fundamental to science and the research project represents a major component of the Honours program. The unit provides the opportunity for students to identify and solve scientific problems logically and creatively. Students are required to relate the project work to published work in the field of study. Project aims to foster enhanced observational skills, relevant practical skills, lateral thinking and problem solving, literacy and communication skills, professional responsibility and ethical conduct, and conduct of scientific research.(60 credit points achieved at completion of NRB720-1, NRB720-2, NRB720-3, NRB720-4 and NRB720-5.)
Credit points: 12 Campus: Gardens Point Teaching period: 2011 SEM-1 and 2011 SEM-2

NRB720 PROJECT
Independent research is fundamental to science and the research project represents a major component of the Honours program. The unit provides the opportunity for students to identify and solve scientific problems logically and creatively. Students are required to relate the project work to published work in the field of study. Project aims to foster enhanced observational skills, relevant practical skills, lateral thinking and problem solving, literacy and communication skills, professional responsibility and ethical conduct, and conduct of scientific research.(60 credit points achieved at completion of NRB720-1, NRB720-2, NRB720-3, NRB720-4 and NRB720-5.)
Credit points: 12 Campus: Gardens Point Teaching period: 2011 SEM-1 and 2011 SEM-2

NRB720 PROJECT
Independent research is fundamental to science and the research project represents a major component of the Honours program. The unit provides the opportunity for students to identify and solve scientific problems logically and creatively. Students are required to relate the project work to published work in the field of study. Project aims to
foster enhanced observational skills, relevant practical skills, lateral thinking and problem solving, literacy and communication skills, professional responsibility and ethical conduct, and conduct of scientific research. (60 credit points achieved at completion of NRB720-1, NRB720-2, NRB720-3, NRB720-4 and NRB720-5.)

**Credit points:** 12  **Campus:** Gardens Point  **Teaching period:** 2011 SEM-1 and 2011 SEM-2

### NRB720 PROJECT

Independent research is fundamental to science and the research project represents a major component of the Honours program. The unit provides the opportunity for students to identify and solve scientific problems logically and creatively. Students are required to relate the project work to published work in the field of study. Project aims to foster enhanced observational skills, relevant practical skills, lateral thinking and problem solving, literacy and communication skills, professional responsibility and ethical conduct, and conduct of scientific research. (60 credit points achieved at completion of NRB720-1, NRB720-2, NRB720-3, NRB720-4 and NRB720-5.)

**Credit points:** 12  **Campus:** Gardens Point  **Teaching period:** 2011 SEM-1 and 2011 SEM-2

### NRB730 RESEARCH METHODS AND STRATEGIES

The unit consists of advanced research discussion and proposal writing. This coursework forms an important component in the development of the research training of the student from the aspects of data acquisition, organisation, planning, and implementation. The aim of the unit is to enable the student to develop and improve research abilities and skills, and to focus their efforts towards their research projects. Such skills are in organisation, but also in locating, identifying and integrating the required background data and other information for the particular study. Specific problems are discussed in detail to help develop critical thinking via a problem solving approach to research issues. Assessment is based on a written research proposal, which includes a comprehensive literature review and on an oral presentation of that proposal. (24 credit points achieved at completion of NRB730-1 and NRB730-2.)

**Credit points:** 12  **Campus:** Gardens Point  **Teaching period:** 2011 SEM-1 and 2011 SEM-2

### NRB735 ADVANCED STUDIES IN RESOURCE SCIENCES

The aim of the unit is to provide an in-depth examination of a global topic, or synthesis of a subject so that the student develops a broad perspective of major issues facing all researchers, regardless of major, in biogeosciences. Important in this unit is the development of an inquiring approach and analytical thought and skills at an advanced level.

**Credit points:** 12  **Campus:** Gardens Point  **Teaching period:** 2011 SEM-1 and 2011 SEM-2

### PCB700 RESEARCH PROJECT

Students undertaking Honours are required to select and undertake, in consultation with a supervisor, a substantial project in an appropriate area. Each project is assessed on the basis of an extensive written report and an oral presentation. (60 credit points achieved at completion of PCB700-1, PCB700-2, PCB700-3, PCB700-4 and PCB700-5.)

**Credit points:** 12  **Campus:** Gardens Point  **Teaching period:** 2011 SEM-1 and 2011 SEM-2

### PCB700 RESEARCH PROJECT

Students undertaking Honours are required to select and undertake, in consultation with a supervisor, a substantial project in an appropriate area. Each project is assessed on
the basis of an extensive written report and an oral presentation. (60 credit points achieved at completion of PCB700-1, PCB700-2, PCB700-3, PCB700-4 and PCB700-5.)

**Credit points:** 12  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-1 and 2011 SEM-2

### PCB700 RESEARCH PROJECT

Students undertaking Honours are required to select and undertake, in consultation with a supervisor, a substantial project in an appropriate area. Each project is assessed on the basis of an extensive written report and an oral presentation. (60 credit points achieved at completion of PCB700-1, PCB700-2, PCB700-3, PCB700-4 and PCB700-5.)

**Credit points:** 12  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-1 and 2011 SEM-2

### PCB700 RESEARCH PROJECT

Students undertaking Honours are required to select and undertake, in consultation with a supervisor, a substantial project in an appropriate area. Each project is assessed on the basis of an extensive written report and an oral presentation. (60 credit points achieved at completion of PCB700-1, PCB700-2, PCB700-3, PCB700-4 and PCB700-5.)

**Credit points:** 12  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-1 and 2011 SEM-2

### PCB706 QUANTUM MECHANICS

Review of operators and their role in quantum mechanics, different representations, Dirac notations and linear vector space, matrix approach to quantum mechanics, eigenvalues and eigenvectors, unitary transformations, R- and P-representations, tensor product of states, six postulates of quantum mechanics, concept of measurements, quantum entanglement, density matrix, general theory of angular momentum, quantum oscillator, two-level systems, non-relativistic theory of spin, spinors, theory of scattering, Born approximation, perturbation theory.

**Prerequisites:** PQB550  
**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-1

### PCB708 ADVANCED TOPICS IN PHYSICS

No more than three topics are included. The content is determined by current research advances, availability of appropriate staff, visiting academics, etc and may vary from year to year.

**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-1 and 2011 SEM-2

### PCB742 ELECTIVE UNIT

The subjects are chosen to suit individual students but the topics studied would normally be in specific areas of physical chemistry, analytical chemistry, inorganic chemistry or organic chemistry and would be chosen from subjects presently offered in the masters program or other post graduate programs. Relevant material from other accredited courses may be included as part or all of the requirement for this subject as directed by the Course Coordinator and Head of School.

**Credit points:** 12  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-1 and 2011 SEM-2

### PCB780 ADVANCED TOPICS IN CHEMISTRY 1

This is the second semester component of a two-semester unit covering a selection of advanced topics in the areas of physical, organic and inorganic chemistry. The topics offered reflect the expertise of the academic staff as well as the needs of the students. (24 credit points achieved at completion of PCB780-1 and PCB780-2.)

**Credit points:** 12  
**Contact hours:** 6 per week  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-2

### PCB780 ADVANCED TOPICS IN CHEMISTRY 1

This is the first semester component of a two-semester unit covering a selection of advanced topics in the areas of physical, organic and inorganic chemistry. The topics offered reflect the expertise of the academic staff as well as the needs of the students. (24 credit points achieved at completion of PCB780-1 and PCB780-2.)

**Credit points:** 12  
**Contact hours:** 6 per week  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-1

### PCN716 ADVANCED TOPICS IN PHYSICS 2

This unit provides a focused theoretical foundation for each students research program or other advanced topics in physics and develops a high level of theoretical understanding of the physical principles involved.

**Credit points:** 12  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-1 and 2011 SEM-2

### PQB660 ASTROPHYSICS 2

Theoretical astrophysics and cosmology are at the forefront in developing comprehensive physical understanding of our world, including natural links between macro and micro...
processes in the Universe. This third level unit is one of the key units in the astrophysics co-major, that presents an advanced undergraduate course in modern theory of gravitation, space-time concept, cosmology, and their relationship with other areas of contemporary physics. You will be required to use the knowledge and skills developed in first and second level physics and maths units. This unit is the 'cap-stone' of the astrophysics co-major. The main aim of this course is to introduce you to one of the most challenging and exciting topics in modern physics - theory of gravitation and relativistic cosmology.

**Prerequisites:** PQB250 or PCB250 or PCB150  
**Equivalents:** PCB669  
**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-2

**PQB661 LASERS AND PHOTONICS**

Laser and photonic technologies are rapidly maturing areas responsible for creating new industries and employment opportunities for scientists and engineers in the areas of information technology, manufacturing, sensing and health. In particular, the vast global optical communications industry has dramatically increased information transport rates through the development of new laser sources and photonic devices. At the heart of all advances in photonics is a greater understanding of light-matter interactions and the processes used to fabricate devices. This unit is offered to science and engineering students who seek to understand the physical principles underpinning lasers and photonic devices and their use in a range of optical technologies.

**Prerequisites:** (PQB251 or PCB260 or EEB340 or ENB242 or ENB343) and (MAB311 or MAB233)  
**Equivalents:** PCB664  
**Credit points:** 12  
**Contact hours:** 4 per week  
**Campus:** Gardens Point  
**Teaching period:** 2011 SEM-2