Biochemistry and Molecular Biology

A specialisation in biochemistry and molecular biology is an important requirement for employment in many biomedical, biotechnological and agricultural fields. The acquisition of basic knowledge in biochemistry and molecular biology is also an important requirement for the training of specialist scientists in a broad range of biological fields. Consequently, biochemistry and molecular biology 521-211 and 521-212; and 521-220 have become central subjects in the BSc courses for many students seeking careers as botanists, geneticists, histologists, microbiologists, pharmacologists, pathologists, physiologists and zoologists. In addition, students specialising in chemistry, physics, mathematics, computer science or chemical engineering with biological interests, also include biochemistry and molecular biology subjects in their studies. The combination of chemistry with biochemistry and molecular biology 521-211 and 521-212 is a particularly useful one; for students wishing to specialise in the field of macromolecular biophysics and bioinformatics, biochemistry and molecular biology 521-203 and 521-307, will be of special interest.

Biological science streams, suggested subjects

For students in the biological science streams planning to include biochemistry and molecular biology subjects in their studies:

100-level subjects

- Biology 600-141 plus 600-142 (before 1996: 600-101).
- Chemistry 610-121 plus 610-122 (before 1998) or 610-141 plus 610-142 (prerequisite subjects) or 610-161 plus 610-162.
- Experimental Design and Data Analysis 620-160
- 620-161 Introductory Mathematics A, 620-141 Mathematics A, or 620-121 Mathematics A (Advanced).
- Physics 25 points at 100 level

200-level subjects

Students intending to proceed to 300-level biochemistry and molecular biology should take biochemistry and molecular biology 521-211 plus 521-212 and 521-220 (or in special circumstances biochemistry and molecular biology 521-024 or 521-203). The most useful combinations of subjects from other disciplines with biochemistry and molecular biology are set out in Table 23. Students are advised that 200-level chemistry is particularly useful for the study of biochemistry and molecular biology; if only two subjects of 200-level chemistry are to be taken, the preferred subjects are 610-210, 610-260 or 610-220, 610-260; if only one 200-level chemistry subject, it should be 610-260.

Table 23: Suggested 200-level subjects

Anatomy and cell biology	516-201, 516-202, 516-204, 516-207
Botany	606-201, 606-202, 606-204
Cell Biology	606-206
Chemistry	610-210, 610-220, 610-240, 610-260
Genetics	652-214, 652-215, 652-216
Microbiology and immunology	526-201, 526-205
Pathology	531-201
Pharmacology	534-201
Physiology	536-201, 536-202, 536-203, 536-211
Zoology	654-201, 654-202, 654-204

300-level subjects

Students intending to specialise in biochemistry and molecular biology should enrol in at least three of the seven lecture subjects and in one or both of the practical subjects 521-321 and 521-322.

Note that students undertaking more than one 300-level practical subject must have passed 521-220, or both 521-221 and 521-222 (before 2001).

Combinations of biochemistry and molecular biology lecture subjects appropriate to a second major study at the 300-level in either discipline are listed in Table 24.

Table 24: Suggested 300-level subjects

Anatomy and cell biology	516-301, 516-303, 516-304, 516-305
Botany	606-301, 606-302, 606-303,
Chemistry	610-310, 610-320, 610-330, 610-360
Genetics	652-301, 652-302, 652-303, 652-304, 652-305, 652-306
Microbiology and immunology	526-301, 526-302
Pathology	531-301, 531-302, 531-303, 531-304, 531-305
Pharmacology	534-301, 534-302, 534-303, 534-304, 534-305
Physiology	536-301, 536-303, 536-304
Zoology	654-301, 654-302, 654-303, 654-304, 654-305

Students wishing to proceed to BSc Honours in the Department of Biochemistry and Molecular Biology should normally undertake at least 50 points of biochemistry and molecular biology at 300-level. Students wishing to proceed to a combined BSc Honours course in chemistry and biochemistry and molecular biology should seek advice from the individual departments on undergraduate course selections.

Macromolecular biophysics and bioinformatics stream

A macromolecular biophysics and bioinformatics stream has recently been established within the BSc degree, commencing at 200-level. The key introductory subject is the biochemistry and molecular biology subject 521-203 Macromolecular Structure &Bioinformatics *(p.785)* (formerly named Macromolecular Structure and Computational Molecular Biology). This subject has been designed for students with a background in the physical sciences who are interested in extending the applications of these disciplines in the following areas: protein and nucleic acid structural analyses, computer graphics-based modelling of the three dimensional structures of these macromolecules and related areas of bioinformatics; the investigation of the molecular dynamics of proteins and protein-protein, protein nucleic acid and protein-ligand interactions (e.g. pharmacological drug-protein receptor interactions); protein folding and the design and engineering of new protein structures. The 200-level subject leads to the 300-level biochemistry and molecular biology subject 521-307 3D-Macromolecular Structure and Dynamics *(p.788)* (formerly named Three Dimensional Structure and Conformational Dynamics of Biological Macromolecules) introduced for the first time in 1997. This subject has a co-requisite for the 300-level subject, 521-301 Protein Structure, Design & Engineering *(p.787)*. It is recommended that a selection of appropriate chemistry and physics and, where appropriate, mathematics subjects, should be taken in combination with 521-203, 521-301 and 521-307 for those students intending to specialise in the field of macromolecular biophysics. For students with the appropriate background in 200-level biochemistry, consideration should also be given to combining 521-307 with the subjects 521-302, 521-321 and 521-322. This combination will provide training in (i) the theoretical and practical aspects of recombinant DNA technology, protein expression and purification necessary for the preparation of many proteins for biophysical analyses, as well as, (ii) bioinformatics relating to the analysis of linear amino acid and nucleic acid sequences.

Biotechnology

The 300-level biochemistry and molecular biology lecture subjects 521-301, 521-302, 521-303, 521-306 and 521-307 are of particular relevance to those intending to pursue a career in the biotechnology field. Both practical subjects 521-321 and 521-322 are relevant, depending on the areas of specific interest. Students interested in subjects that emphasise biochemical aspects of biotechnology should consult the Graduate Diploma in Biotechnology entry in the Postgraduate Handbook and seek further advice from the Department.

Bachelor of Science (Honours)

For information about the faculty and departmental entry requirements for honours, please refer to *Bachelor of Science (Honours) and Bachelor of Information Systems (Honours) (p.883)*. These requirements should be considered when planning your course.

200-level subjects

521-203 Macromolecular Structure &Bioinformatics

Note: This subject is strongly recommended for those intending to enrol in 521-307.

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr P R Gooley

Prerequisites: Chemistry 610-121 plus 610-122 (before 1998) or 610-141 plus 610-142.

Contact: 24 lectures (two a week); 24 hours of computer workshops and tutorials (one 2-hour session each week) *(Semester 2).*

Description: By the end of the program the student should have acquired knowledge of the fundamental concepts of protein and nucleic acid structure, function and bioinformatics (computational molecular biology) necessary for those who wish to continue studies in relevant areas of biophysics, bioinformatics, protein engineering and rational drug design; an overview of the theory of methodologies for the determination and computational analyses of macromolecular structures; an appreciation of the Human Genome Project and its impact on the developing fields of bioinformatics, functional genomics, protein pharmaceuticals and drug discovery; and basic practical skills in the use of personal computers and molecular graphics software for the analysis and molecular modelling of protein and nucleic acid structures derived from relevant sequence data bases. The content includes an overview of protein and nucleic acid structure and function; sequence determination of proteins and nucleic acids, strategies involved in the human genome and related sequencing programs; applications of genome sequence data with a particular emphasis on gene products of pharmaceutical relevance; protein sequence alignments; algorithms for predicting protein structure and folding; functional motif consensus sequences; energy minimisation of peptide structures; protein-solvent and protein-ligand interactions; DNA-protein interactions; and practical training in the use of molecular graphics for analysing and modelling protein and nucleic acid three-dimensional structures.

Assessment: A 2-hour end-of-semester written examination (80%) plus computer assignments including a written report (20%).

521-204 Biochemistry and the Eye

Note: This subject is only available to students enrolled in the Bachelor of Optometry course.

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr J Down; Dr M Kalloniatis

Prerequisites: Biology 600-141 plus 600-142 and Chemistry 610-141 plus 610-142.

Contact: 42 hours of lectures (four per week for first five weeks and three per week thereafter) and six tutorials (one per week) *(Semester 1).*

Description: The principal objectives are to develop: an understanding of the relationships between chemical properties and functions of body constituents, metabolic and regulatory processes, particularly in relation to the eye and other tissues which have a major influence on the function and maintenance of the eye; an appreciation of the biochemical basis of diseases of the eye; and an appreciation of the role of experimentation in the development of biochemical knowledge and the clinical relevance of ocular biochemistry and molecular biology. Major topics covered include the structure, function and metabolism of proteins, carbohydrates, lipids, mucopolysaccharides and nucleic acids; nutrition, digestion and absorption; specialised functions of proteins, lipids and proteoglycans, particularly in relation to immunological defense, bioenergetics, ion transport, the composition and function of tears, lens and aqueous humour, and photopigments and the visual cycle; intracellular mechanisms controlling biochemical process and transmitting signals, particularly in relation to visual phototransduction, retinal neurochemistry and the actions of hormones relevant to the development and maintenance of eye tissues; and basic principles of gene structure and expression and the genetic basis of eye disorders.

Assessment: A 3-hour end-of-semester written examination (85%) and a short mid-semester test (15%)

521-211 Biochemistry & Molecular Biology Part A

Note: Not available to students enrolled in the BBiomedSc.

Credit points: 12.5 **HECS-band:** 2

Coordinator: Mr G R Parslow

Prerequisites: Chemistry 610-121 and 610-122 (before 1998) or 610-141 plus 610-142 or 610-161 plus 610-162. Biology 600-141 plus 600-142 are strongly recommended.

Contact: 36 lectures (three a week); 12 hours of computer-based tutorials *(Semester 1).*

Description: By the end of the subject the student should have acquired knowledge of the fundamental areas of biochemistry and molecular biology relating to the structure, function and chemical properties of biological molecules; a detailed understanding of the structure and function relationships of proteins, lipids, carbohydrates and nucleic acids; and an appreciation of the fundamentals of molecular cloning and recombinant DNA technology and DNA replication and repair. Content includes introduction to the principles of cellular functions; amino acid chemistry; acid base implications in biochemistry; preparation and purification of proteins; structure and function of proteins with particular attention given to serum proteins, haemoglobin and immunoglobulins; properties of enzymes and their regulation; lipid chemistry; biomembrane composition, architecture, dynamics and function including membrane transport processes; carbohydrate structure and function; the structure of nucleic acids, DNA helices and implications for roles as genetic material; molecular cloning and recombinant DNA technology, DNA replication; and repair mechanisms.

Assessment: Computer-based tests of knowledge gained in computer tutorials (10%); a 3-hour written examination at the end of the semester (90%).

521-212 Biochemistry & Molecular Biology Part B

Note: Not available to students enrolled in the BBiomedSc.

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr D L Ebert

Prerequisites: Biochemistry and Molecular Biology 521-211.

Contact: 36 lectures (three a week); 12 hours of computer-based tutorials *(Semester 2).*

Description: By the end of the program the student should have acquired knowledge of the fundamental areas of biochemistry and molecular biology relating to the biochemistry of genetic and metabolic processes, including a detailed understanding of the principal metabolic pathways and their control, the molecular processes involved in gene expression and its regulation. The content includes mutagenesis; expression, transcription and translation of genes to yield functional proteins; mechanism of action of antibiotics; regulation of gene expression; applications of molecular cloning and recombinant DNA in the investigation of gene structure, function and regulation; major pathways for the catabolic and anabolic metabolism of carbohydrates, lipids and nitrogen-containing compounds in mammalian cells; bioenergetics and mitochondrial function; photosynthesis and carbon fixation; and metabolic control including introduction to the actions of hormones and lipid soluble vitamins and their intracellular signalling pathways.

Assessment: Computer-based tests of knowledge gained from computer tutorials (10%). A 3-hour written examination at the end of the semester (90%).

521-213 Integrated Biomedical Science I

Note: This subject is only available to students undertaking the Bachelor of Biomedical Science.

Credit points: 25 **HECS-band:** 2

Coordinator: Dr T Lithgow

Prerequisites: Biology 600-131 and 600-132

Contact: 6 hours of lectures and 3 hours of practicals and self-directed computer-based learning exercises per week *(Semester 1).*

Description: This multidisciplinary subject deals with a blend of biochemistry, molecular and cell biology, tissue biology and physiology, which aims to develop knowledge of the relationship between the structure and function of the major classes of biomolecules, higher ordered structures and cells, as well as the contribution these molecules make to cellular, tissue and whole systems biology.

The biochemistry component will consist of 36 lectures on the following topics: chemistries and solution properties of the major classes of biological compounds; structure and function of proteins, lipids, biological membranes and nucleic acids; enzymology and the biochemistry of digestion and absorption; and introduction to recombinant DNA technology.

The cell and tissue biology stream (24 lectures) will concentrate initially on the histology and ultrastructure of cells and basic tissue types, epithelium, muscle, nerve, haemopoietic and connective tissues; and then consider the organisation of the major organs and the structure and function of cellular organelles, cytoskeletal structures and the extracellular matrix.

The introductory physiology stream (12 lectures) will concentrate on mammalian (especially human) physiology and build on comparative aspects covered in first year biomedical biology core subjects. The focus will be on the building blocks: homeostasis, the relationship between organs and organ systems, cell physiology, excitable cells and electrolyte transport. The practical work will be designed to develop basic experimental, data analysis and interpretation skills in biochemistry, physiology and cell and tissue biology techniques.

Assessment: Two 2-hour end-of-semester examinations on the theory and practical work (70%); laboratory practical work (15%); two short written assignments (each 500 words) and computer-based tests (15%)

521-220 Techniques in Protein & Gene Technology

Note:

- Not available to students enrolled in the BBiomedSc.
- Students must advise the Department of Biochemistry and Molecular Biology during the two weeks before the start of semester of their order of preference for the alternative class times; as well as the other subjects they will be taking.
- Students may only gain credit for one of 521-220 and 521-221.

Credit points: 12.5 **HECS-band:** 2

Coordinator: Mr G Parslow

Corequisites: Biochemistry and molecular biology 521-211

Contact: 12 lectures (one per week), 12 hours of computer assisted learning (to be completed in four blocks) and 36 hours practical work (3 hours per week) *(Semester 1, repeat 2).*

Description: The subject is intended as a skills course for all students taking life science subjects and combined degrees. This subject should be undertaken by students contemplating any third year level study in life science and the subject is a specific prerequisite for most subjects offered by the Department of Biochemistry and Molecular Biology in third year. The subject is conceptually organised in three major divisions:

- basic skills, experimental accuracy and data interpretation
- separation and handling of proteins
- separation and handling of nucleic acids

The lectures will provide a summary of the theory of classic laboratory techniques that continue as the main activity of research in biochemistry and molecular biology. In addition new technologies that students may encounter in the emerging fields of genomics and proteomics will be described. Progress in research is predicated not only on asking appropriate questions, but on having the laboratory support and skills to investigate those questions. Students will be able to develop skills of preparation, execution and interpretation of laboratory procedures within the context of performing:

- chromatographic separation of small and large biological molecules
- estimations of cellular metabolites and macromolecules
- determination of kinetic parameters of glucose-6-phosphate dehydrogenase
- purification of the enzyme lysozyme
- purification and characterisation of chromosomal and plasmid DNA
- restriction mapping of the lambda phage genome
- interrogation of computer databases in life sciences

Assessment: Written reports of experiments, and related exercises, due at specific times after the completion of each activity (50%); a 2-hour written examination (40%) and credit for computer assisted learning (10%)

Prescribed texts: K Wilson and J Walker, *Principles and Techniques of Practical Biochemistry*, 5th Ed., Cambridge University Press, 2000.

521-221 Biochemistry & Molecular Biology Lab PtA

Note:

- Not available to students enrolled in the BBiomedSc.
- Students must advise the Department of Biochemistry and Molecular Biology during the two weeks before the start of semester of their order of preference for the alternative class times; as well as the other subjects they will be taking.
- Students may only gain credit for one of 521-220 and 521-221.

Credit points: 6.25 **HECS-band:** 2

Coordinator: Mr G R Parslow

Corequisites: Biochemistry and molecular biology 521-211.

Contact: 36 hours practical work (3 hours a week) *(Semester 1).*

Description: By the end of the program the student should have developed observational, organisational and practical skills in obtaining data using modern biochemical procedures, and in analysing, reporting, evaluating and interpreting experimental findings. Students should also have developed an appreciation of how practical studies of biochemistry and molecular biology can augment the theoretical studies of the discipline. The content includes introduction to modern methods of analysis with an emphasis on computer-based spectrophotometry; common techniques used in the purification and analysis of macromolecules, particularly proteins of biochemical and clinical importance; assay and data analysis of enzyme activity; and introduction to the use of computers for data collection, presentation and analysis. A conditional exemption from experiments that use animal materials may be granted in some circumstances by the head of the department.

Assessment: Continuous assessment (65%) and tests during the practical session times (35%).

300-level subjects

521-301 Protein Structure, Design & Engineering

Credit points: 12.5 **HECS-band:** 2

Coordinator: Assoc Prof G J Howlett

Prerequisites: Biochemistry and molecular biology 521-211, 521-212 and either 521-221 or 521-220; or 521-203; or 521-024; or 521-213 plus physiology 536-250.

Contact: 36 lectures (three a week) *(Semester 1).*

Description: By the end of the course the student should have developed an appreciation of the impact of structural biology on biomedical research and biotechnology, and also an understanding of the structural properties of proteins. The subject matter addresses how proteins fold *in vivo* and *in vitro*; how protein design and engineering are used for investigating structure-function relationships; and the challenges of producing recombinant proteins for pharmaceutical and industrial applications. The theoretical background to the major techniques used in modern protein chemistry and their applications in biotechnology will also be covered. The following topics will be presented: general properties of protein structure; the major classes and topologies of proteins; evolution of sequence, structure and function; protein folding and molecular chaperones; protein design for biotechnology; designing proteins de novo; computer-based prediction of protein fold; binding of small molecules to proteins and drug design; protein-protein interactions; transcription factors and their interactions with DNA; effects of point mutations on tertiary structure, protein stability and biological functions; and enzyme reaction kinetics. Examples from the classical and current scientific literature will include immunoglobulins and other protein mediators of immune responses, recombinant chimeric antibodies and immunotoxins, plasminogen activators, transcription factors and protein mediators of signal transduction.

Assessment: A 2.5-hour end-of-semester written examination (80%) plus continuous assessment based on up to four short tests, (20%)

Prescribed texts: C Branden and J Tooze, *Introduction to Protein Structure*, 2nd ed., Garland, 1998.

521-302 Functional Genomics

Credit points: 12.5 **HECS-band:** 2

Coordinator: Prof M-J Gething

Prerequisites: Biochemistry and molecular biology 521-211, 521-212 and either 521-220, 521-221 plus 521-222 (prior to 2001); or 521-024; or 521-213 plus physiology 536-250.

Contact: 36 lectures (three a week) *(Semester 2).*

Description: By the end of the program the student should have developed a detailed understanding of current concepts concerning molecular aspects of evolution, the molecular bases of genome structure and gene expression and the regulation of gene expression in prokaryotic and eukaryotic organisms (animals and plants); a theoretical background to recombinant DNA technology and an appreciation of its biomedical and biotechnological applications; an appreciation of the significance and applications of human and related genome sequencing programs; and the ability to read critically original scientific literature in the field. Subject content includes structure of genes and chromosomes; molecular aspects of transcription and RNA maturation; regulation of gene expression at the transcriptional and translational levels; gene expression profiling and proteomics; ribosome biogenesis as a major example of the co-ordination of gene expression and RNA processing; re-arrangements of the genome; proto-oncogenes and tumour suppressor genes; identification and functional characterisation of candidate genes for human familial disease (major example, breast cancer); molecular aspects of evolution; ribozymes and the catalytic and antisense functions of RNA; applied genomics; and recombinant DNA technology, including recombinant protein expression systems with particular reference to investigations based on transfected cell culture, transgenic and gene knockout systems.

Assessment: A 2.5-hour end-of-semester written examination (80%) plus continuous assessment based on up to four short tests and/or oral presentation and written assignment (20%).

Prescribed texts: H Lodish et al, *Molecular Cell Biology*, 4th ed., Sci. Amer. Books, 2000.

521-303 Molecular Aspects of Cell Biology

Credit points: 12.5 **HECS-band:** 2

Coordinator: Assoc Prof M McConville; Dr T Lithgow

Prerequisites: Biochemistry and molecular biology 521-211, 521-212 and either 521-220 or 521-221; or 521-203; or 521-024; or 521-213 plus physiology 536-250.

Contact: 36 lectures (three a week) *(Semester 1).*

Description: To complement the information explosion of the new genomic era, it is essential to appreciate the cellular architecture of cells and how the delivery of proteins to their correct locations in the cell is crucial for the complex intracellular signalling pathways that control cell morphology, organisation and behaviour.

By the end of the subject the student should have acquired an understanding of the relationships between molecular design, cellular organisation and biological function of normal, stressed and malignant eukaryotic cells, as well as detailed knowledge of the major experimental strategies for investigating the molecular basis of these relationships. The content includes compartmentalisation in eukaryotic cells; intracellular RNA and protein traffic and the role of molecular chaperones in trafficking; the molecular structure, function and biogenesis of subcellular organelles; protein folding and maturation pathways within eukaryotic cells; structure, function and dynamics of membrane recep-

tors; structure and function of the extracellular matrix, cell adhesion molecules and the role of extracellular proteolysis, including in diseased states such as malignancies; cellular stress responses and linked signal transduction events; cytoskeletal components including actin, actin-binding proteins, myosin, tubulin, intermediate filaments, and the signal transduction processes regulating the assembly and disassembly of actin-cytoskeletal structures; and molecular processes determining cell movement and shape changes.

Assessment: A 2.5-hour end-of-semester written examination (80%) plus continuous assessment based on up to four short tests and/or oral presentation and written assignment (20%).

Prescribed texts: B Alberts et al, *Molecular Biology of the Cell*, 3rd ed., Garland, 1994. **or** H Lodish et al, *Molecular Cell Biology*, 4th ed., Sci. Amer. Books, 2000.

521-304 Hormone & Neurotransmitter Biochemistry

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr B G Livett

Prerequisites: Biochemistry and molecular biology 521-211, 521-212 and either 521-220 or 521-221; or 521-024; or 521-213 plus physiology 536-250. In special circumstances the head of the department may permit some students who have not taken 521-221 to enrol in this subject.

Contact: 36 lectures (three a week) *(Semester 2).*

Description: By the end of the subject the student should have acquired an understanding of the molecular basis of endocrinology, neuroendocrinology and relevant areas of metabolism; an appreciation of the similarities in the mechanism of actions of hormones, polypeptide growth factors, cytokines and neuro-transmitters; an understanding of techniques used to investigate the molecular basis of hormone and neurotransmitter action; and an overview of areas of metabolism subject to hormonal and neurotransmitter control. The subject includes endocrine systems producing individual hormones; biosynthesis, storage and secretion of hormones and neurotransmitters; hormone receptors and mechanisms in signal transduction, with particular emphasis on second messenger, protein phosphorylation, and other cell signalling-dependent pathways; metabolic targets for regulation and rate limiting steps in metabolism; hormonal regulation of gene expression; metabolic consequences of regulation by hormones and neurotransmitters; structure, function and mechanism of action of nerve growth and other growth and differentiation factors; molecular recognition events of importance during the development of the nervous system; tissue specialisation within the nervous system and the different roles of individual neurotransmitters; the neurochemistry of myelin; and molecular basis of multiple sclerosis, Parkinson's, Huntington's, Alzheimer's and other neurological diseases.

Assessment: A 2.5-hour end-of-semester written examination (80%) plus continuous assessment based on up to four short tests and/or written assignments (20%).

521-305 Biochemistry of Metabolism & Nutrition

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr D L Ebert

Prerequisites: Biochemistry and molecular biology 521-211, 521-212 and either 521-220 or 521-221; or 521-024; or 521-213 plus physiology 536-250. In special circumstances the head of the department may permit some students who have not taken 521-221 to enrol in this subject.

Contact: 36 lectures (three a week) *(Semester 1).*

Description: By the end of the subject the student should understand the relationships between nutrients, vitamins and the metabolic processes of the typical mammal, metabolic integration and homeostasis, metabolic basis of adaptive responses to a variety of dietary, hormonal and environmental factors, the physiological and biochemical processes governing muscle protein metabolism and its regulation, the regulation of lipoprotein gene expression, and lipid metabolism and transport mechanisms in normal and diseased states. Subject content includes overview of whole animal nutrition and metabolism including tissue specialisation; adaptive responses and the molecular basis for regulation of enzymes, nutrient carrier proteins and relevant cell receptors; mechanism of action of lipid soluble vitamins; integrated aspects of carbohydrate, lipid and protein/amino acid metabolism; energy-transducing membranes and modern concepts of bioenergetics; ion pumps and their regulation; regulation of muscle protein metabolism in response to endurance training, excessive feeding, starvation, physical trauma, and related endocrine (hormonal) and other clinical diseases; regulation of muscle protein gene expression; the biochemical basis of anabolic drugs; dietary fate of lipids, lipid transport mechanisms and the regulation of lipoprotein gene expression and metabolism; and biochemical basis of obesity and cardiovascular disease and related nutritional problems, as well as adaptive responses to excessive consumption of alcohol.

Assessment: A 2.5-hour end-of-semester written examination (80%) plus one short oral and one written assignment during the semester (20%).

Prescribed texts:

Lecture handouts and a list of specific textbooks and other references will be made available at the beginning of the course.

521-306 Plant Biochemistry & Biotechnology

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr K R Gayler; Prof A Bacic

Prerequisites: Biochemistry and molecular biology 521-211, 521-212 and either 521-220 or 521-221; or 521-213 plus physiology 536-250; or biochemistry and molecular biology 521-211 and botany 606-205 and 606-206. Other combinations that provide a similar background will be considered by the coordinators.

Contact: 36 lectures (three a week) *(Semester 2).*

Description: By the end of the program the student should have acquired an overall appreciation of the application of biotechnology to agriculture, horticulture, forestry and the food industry, a detailed understanding of those aspects of biochemistry and cell biology which will contribute unique properties to plants and current techniques for their investigation and manipulation including genetic engineering and plant transformation.

The subject content includes cellular and molecular processes underlying the regulation of basic plant functions, including the modes of action of plant hormones; a detailed knowledge of photosynthetic light reactions and carbon and nitrogen metabolism associated with plant growth and development, a detailed knowledge of structure and functions of plant lipids and of cell wall carbohydrates; an insight into cell-cell recognition and signalling during plant development and the response to pathogens and symbionts, and an understanding of the organisation of the genome in plants and its modification by biotechnology.

Assessment: A 2.5-hour end-of-semester written examination (75%); plus one short oral (5%) and a written assignment of no more than 2000 words (20%).

521-307 3D-Macromolecular Structure and Dynamics

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr P Gooley

Prerequisites: Biochemistry and molecular biology 521-301 (521-203 is strongly recommended); or 521-213 plus physiology 536-250. Students should note that the teaching of this subject will assume a sound knowledge of the relevant principles of chemistry to the standard of the prerequisites for 521-203; students who have not completed 521-203 should seek advice from the Department before enrolling in this subject.

Contact: 24 lectures (two a week); 36 hours of practicals and workshops *(Semester 2).*

Description: By the end of the subject the student should understand the methods used for the determination of three-dimensional structures of proteins and nucleic acids by nuclear magnetic resonance (NMR) and X-ray crystallography; spectroscopic methods for investigating the conformations and solution properties of biological macromolecules; the principles of protein molecular dynamics and their applications in investigations of protein structure and function; the theory and practice of experimental investigations of macromolecular recognition and other interactions; and advanced practical skills in computational analysis of protein NMR, X-ray crystallography and molecular dynamics data and the molecular modelling of the structures of proteins and their ligands. Subject content includes principles and practice of methods for determining the three dimensional structures of proteins and nucleic acids, including X-ray crystallography and nuclear magnetic resonance spectroscopy; spectroscopic methods for determining the conformations of proteins and nucleic acids in aqueous solution: absorption, fluorescence and circular dichroism spectroscopy; molecular dynamics of proteins and the principles of macromolecular recognition including computer-based modelling.

Assessment: A 2-hour end-of-semester written examination (70%) plus continuous assessment of a laboratory based component (30%).

521-308 Genome Science

Note: This subject is only available to students undertaking the Bachelor of Biomedical Science.

Credit points: 12.5 **HECS-band:** 2

Coordinator: Assoc Prof K Gayler

Prerequisites: Biochemistry and molecular biology 521-213 and physiology 536-250.

Contact: 2 hours of lectures (total 24 hrs) and 3 hours of practicals (total 36 hrs) and computer-based self-directed learning exercises per week *(Semester 1).*

Description: The subject aims to develop knowledge, skills in and an understanding of the rationale and experimental strategies and computational sequence analyses being used in the major international genome programs

(particularly the Human Genome Program) and an appreciation of the potential for future applications of this knowledge.

The subject will be organised into three components: (i) a lecture series; (ii) computational molecular biology (bioinformatics) exercises; and (iii) research laboratory placements.

The lecture course will cover the following areas: an overview of current progress in the Human Genome Program; general experimental strategies for complete structural characterisation of the genome; functional significance of the overall chromosomal DNA architecture; molecular basis of DNA finger printing; organisation of genes; information content of DNA including non-standard genetic code; structural patterns within genes and associated regulatory regions; functional genomics emphasising strategies for the identification of new genes and the characterisation of their encoded proteins; the concept of cell-specific proteomes reflected by 2-dimensional electrophoretic characterisations of total protein extracts of cells; comparative and evolutionary chromosome organisation and gene patterns; and principles of computational molecular biology (bioinformatics) directed towards DNA and protein sequence alignments, pattern recognition, evolutionary comparisons and molecular modelling of protein structures. In addition, ethical issues relating to the potential application of the new genetics arising from genome structural characterisation will be considered.

The computer-based exercises will aim to develop skills in sequence data retrieval, sequence alignments and pattern recognition. The research laboratory placements will be designed to provide students with skills in research laboratory work, library research, report writing and team work in a relevant area of genome science.

Assessment: 2-hour end-of-semester examination on the theory and practical components of the subject (70%); interactive computer exercises (10%); research report (20%)

521-321 Gene Technology & Protein Expression

Note: Before the commencement of the semester, students must advise the Department of Biochemistry and Molecular Biology of their order of preference for the alternative practical sessions and the other subjects they will be taking.

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr K Gayler; Dr T Lithgow; Mrs B Bencina

Prerequisites: Biochemistry and molecular biology 521-211, 521-212 and either 521-220 or 521-221; or 521-024; or 521-213 plus physiology 536-250.

Contact: 48 hours practical work (4 hours a week) plus 12 hours of lectures (one per week) *(Semester 1).*

Description: By the end of the subject the student should have extended their training in the basic skills of experimental design, advanced laboratory-based biochemical and gene technology techniques, data analyses and data interpretation, and applied these skills to a number of biotechnological investigations, particularly the use of recombinant DNA technology for the investigation of gene structure and expression, and for expression and analysis of recombinant proteins. Students will also be trained in computer-based storage and analysis of biological data. Specific experiments will deal with nucleic acids, plasmid purification, gene cloning, restriction endonuclease mapping and other aspects of recombinant DNA technology; the theory and practice of protein purification and other techniques appropriate to the handling and analysis of proteins and enzymes created in recombinant expression systems; and the use of computers in the storage, retrieval and analysis of nucleotide sequence data and aspects of bioinformatics. There will also be discussions in seminars of experimental methods for the study of nucleic acids and exercises in literature research including an oral presentation by students of their findings. The experimental work will be organised into elective streams, one of which will involve an opportunity to undertake relevant project work within one of the Department's research laboratories (a quota will apply for project work).

Assessment: Three components will be assessed: 1. laboratory skills and practical management of the experimental program; 2. written research report(s); 3. a written assignment of up to 2000 words or a 2-hour written examination (to be advised at the commencement of the subject).

521-322 Protein Biochemistry and Proteomics

Note: Special requirements: Before the commencement of the semester, students must advise the Department of Biochemistry and Molecular Biology of their order of preference for the alternative practical sessions and the other subjects they will be taking.

Credit points: 12.5 **HECS-band:** 2

Coordinator: Dr G Howlett; Dr P Gooley; Mrs B Bencina

Prerequisites: Biochemistry and molecular biology 521-211, 521-212 and either 521-220 or 521-221; or 521-024; or 521-213 plus physiology 536-250.

Contact: 48 hours practical work (4 hours a week) plus 12 hours of lectures (one per week) *(Semester 2).*

Description: By the end of the subject the student should have developed skills in the experimental approaches and techniques used in advanced investigations of protein structure, and in the critical evaluation of the experimental data derived from such methods; applied these skills to a number of specific protein-based experimental systems; and developed skills in computer applications, including experimental simulations and graphics applications relevant to protein chemistry and proteomics. The content will include modern biochemistry methods and database analysis for characterising protein structure, function and expression; experiments that emphasise aspects of protein unfolding, determination and analysis of ligand binding data; and the use of computers in the analysis and prediction of protein structure. Students will be required to present written accounts of experimental results and use computers for analysing results and molecular graphics applications. Experimental work will be organised into elective streams, one of which will involve an opportunity to undertake relevant project work within one of the Department's research laboratories (quota will apply).

Assessment: Three components will be assessed: 1. laboratory skills and practical management of the experimental program; 2. written research report(s); 3. a written assignment of up to 2000 words or a 2-hour written examination (to be advised at the commencement of the subject).