CRS1400351 Associate Degree in Biomedical Engineering – Curriculum Map

The Associate Degree in Biomedical Engineering provides graduates with the practical ability and theoretical understanding necessary to enter employment at a paraprofessional engineer level and/or to articulate into relevant undergraduate engineering degree courses. The qualification was developed to respond to the workforce development needs of the growing biomedical engineering industry in South Australia.

The program gives students a firm foundation in both theoretical study and practical skills. Students are encouraged to experiment and explore ideas through project-based learning activities, thus developing graduate employability attributes essential to Australia's technology-based industries.

Graduate Attributes

The graduate of this course will have developed the following knowledge and skills:

1. KNOWLEDGE AND SKILL BASE

1.1 Descriptive, formula-based understanding of the underpinning science and engineering fundamentals applicable to biomedical engineering.

1.2 Procedural level understanding of the mathematics, and computer science concepts which underpin biomedical engineering.

1.3 In depth practical knowledge and skills in biomedical engineering.

1.4 Awareness of current research and emerging technologies in biomedical engineering.

1.5 Knowledge and understanding of contemporary workplace practices in biomedical engineering.

2. ENGINEERING APPLICATION ABILITY

2.1 Application of problem-solving techniques to conceptualise a solution to a biomedical engineering problem.

2.2 Application of design and analysis techniques to electronic subsystems comprising hardware and software, as part of a biomedical engineering system.

2.3 Implementation of an electronic subsystem design through an operational prototype.

2.4 Application of established technical and practical methods to assess the operational compliance of a biomedical instrumentation subsystem and modify it to obtain compliance.

2.5 Application of project management techniques to actively participate in the management of human and physical resources of biomedical engineering operational services.

2.6 Application of established technical and practical methods to select, install, commission and maintain biomedical equipment.

3. PROFESSIONAL AND PERSONAL ATTRIBUTES

3.1 Effective participation in team activities and be able to evaluate his/her contribution.

3.2 Effective communication with the engineering team, members of the health care team and the broader community.

3.3 Understanding of and commitment to professional and ethical responsibilities.

3.4 Creative, innovative and pro-active demeanour.

3.5 Professional use and management of information.

3.6 Orderly management of self and professional conduct.

Note: The course outcomes reflect and are mapped against the Engineers Australia's Stage 1 Competency Standard for Engineering Associate.

The course structure consists of 15 core subjects and 2 elective choices taught over 4 semesters of study.

First Year			**Credit Points**
First Semester	Engineering Practice 1	ENGPRAC401	4.5
	Mathematics 1	ENGMATH401	4.5
	Digital Electronics	ENGDEL501	4.5
	Basic Electrical Circuits	ENGCIRC501	4.5
Second Semester	Anatomy and Physiology for Biomedical Technologists	ENGANAT401	4.5
	Electronic Circuits	ENGCIRC601	4.5
	Computer Science 1	ENGCOMP501	4.5
	Mathematics 2	ENGMATH501	4.5
Second Year			
First Semester	Biomedical Instrumentation 1	ENGBIO601	4.5
	Advanced Analog Electronics	ENGAEL602	4.5
	Elective		
	Elective		
Second Semester	Biomedical Instrumentation 2	ENGBIO602	4.5
	Engineering Science	ENGSCI601	4.5
	Project Management	ENGPMGT601	4.5
	Biomedical Project	ENGBPRO601	4.5
	Exposure to Engineering Practice	ENGEXP601	0
Electives	Mathematics 3	ENGMATH601	4.5
	Computer Networks	ENGCOMP602	4.5
	Computer Science 2	ENGCOMP601	4.5
	Engineering Practice 2	ENGPRAC602	4.5
	Microcontroller Programming	ENGMPR601	4.5
	Biomedical Unspecified Elective 1	ENGUNSP601	4.5
	Biomedical Unspecified Elective 2	ENGUNSP602	4.5
		Total Credit Points	**72**

Semester 1 Year 1				
Subject Title	**ENGINEERING PRACTICE 1**	**MATHEMATICS 1**	**DIGITAL ELECTRONICS**	**BASIC ELECTRICAL CIRCUITS**
Subject Code	ENGPRAC401	ENGMATH401	ENGDEL501	ENGBEC501
Credit Points	4.5	4.5	4.5	4.5
EFTSL	0.1248	0.1248	0.1248	0.1248
Topics	Assembly and inspection of printed circuit boards (PCBs) as per current IPC standard WHS and Workplace Practices Fabrication	Numerical Computation Fundamental operations with algebraic expressions Algebraic fractions Indices and radicals Transposition Special products Factorisation Trigonometry Complex numbers Trigonometric identities Linear function Systems of linear equations Quadratic function and quadratic equations Trigonometric functions Exponential and logarithmic function *Writing a scientific report*	Introduction to digital electronics Digital electronic circuits concepts Combinational logic Sequential logic (types, timing, applications, troubleshooting) Integrated circuit families MSI logic circuits (types, applications, troubleshooting) Microcontrollers	Electrical circuits concepts DC circuits Test and measurement techniques for DC circuits AC circuits Test and measurement techniques for AC circuits Design considerations (through-hole vs SMT, environmental, power rating, tolerances, etc.) Basic amplifier theory Introduction to op amps *Technical report writing*
Learning Outcomes	1. Demonstrate an understanding of one's responsibilities for health and safety, and for adherence to safety practices. 2. Identify and analyse hazards and risks related to WHS in the workplace. 3. Safely use electronics assembly tools. 4. Perform basic mechanical measurements, including marking-out and reading mechanical and electronics diagrams. 5. Use fabrication techniques to construct, repair and facilitate the installation of electronic and computer systems components. 6. Perform electronic printed circuit board assembly and disassembly using industry-standard soldering techniques. 7. Identify and analyse sustainable work practices. 8. Apply principles of effective team participation.	1. Solve engineering problems involving arithmetic, simple algebra and trigonometry. 2. Use mathematical reasoning and a generalized problem-solving process. 3. Use appropriate technology to solve mathematical problems, and judge the reasonableness of the results. 4. Communicate mathematical reasoning and ideas using appropriate language and representations, such as symbols, equations, tables, and graphs.	1. Define electronics theoretical concepts as applied to digital electronic circuits and microcontrollers. 2. Explain the operation of digital electronic circuits comprising logic gates, combinational logic, flip-flops and related devices, counters and registers and MSI logic circuits. 3. Analyse the performance of digital electronic circuits and subsystems. 4. Use computer simulation for basic analysis of digital electronic circuits. 5. Prototype basic digital electronic circuits based on a given schematic diagram. 6. Correctly measure basic digital electronic circuit parameters using appropriate equipment. 7. Summarise and report the measured parameter values in commonly used engineering format. 8. Design of basic digital electronic circuits. 9. Design, write, test and debug assembly language programs for microcontrollers.	1. Define fundamental electrical theoretical concepts as applied in basic electronic circuits and amplifiers. 2. Explain the operation of a basic electronic circuit. 3. Calculate the parameters of a basic electronic circuit and amplifier using circuit analysis techniques. 4. Use computer simulation for basic analysis of electronic circuits. 5. Prototype basic electronic circuits and amplifiers based on a given schematic diagram. 6. Correctly measure basic electronic circuit and amplifier parameters using appropriate equipment. 7. Summarise and report the measured parameter values in commonly used engineering format.
Ave Weekly Contact	7 hours	6 hours	6 hours	5 hours
Ave Weekly Independent Learning	1 hour	2 hours	2 hours	3 hours
Total Hours (Semester)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)
Assessment	Practical component – Soldering 25% Practical component – Fabrication 25% WHS investigation 20% Sustainability investigation 10% Project 20%	Assignment 15% Test 1 20% Test 2 20% Final Exam 45%	Test 1 10% Test 2 10% Practical component 15% Project 25% Final exam 40%	Test 1 10% Test 2 10% Practical component 20% Project 25% Final exam 35%
Co-/Pre-requisites	nil	nil	Co-requisite: Basic Electrical Cuircuits	Co-requisite: Mathematics 1

Semester 2 Year 2				
Subject Title	**ANATOMY AND PHYSIOLOGY FOR BIOMEDICAL TECHNOLOGISTS**	**ELECTRONIC CIRCUITS**	**COMPUTER SCIENCE 1**	**MATHEMATICS 2**
Subject Code	ENGANAT401	ENGCIRC601	ENGCOMP501	ENGMATH501
Credit Points	4.5	4.5	4.5	4.5
EFTSL	0.1248	0.1248	0.1248	0.1248
Topics	Infection Control Medical terminology Basic anatomy and physiology	Introduction to semiconductors Diode Power supplies Bipolar Junction Transistor (BJT) Field effect transistors Mesh and nodal analysis *Advanced presentation skills*	Fundamental programming structures and syntax Introduction to algorithms and data structures Introduction to object-oriented programming Using IDEs to write, test and debug code *Team Communication Skills: Listening and Giving Feedback* *Presentation skills*	Linear Algebra Topics: • Introduction to Matlab • Matricies and linear equations • Vector spaces • Determinants Calculus Topics: • Introduction to Matlab • Limits • Derivatives • Integration • Functions • Integration Techniques • Numerical integration *Using technical report writing skills*
1. **Learning Outcomes**	2. Apply appropriate infection control standards in a health care setting. 3. Employ approved health care terminology and abbreviations to document and communicate with members of the healthcare team. 4. Demonstrate a basic level of knowledge regarding the anatomy and physiology of the 12 body systems. 5. Describe the relationships between body systems required to support a healthy body.	1. Define fundamental electrical theoretical concepts as applied in semiconductor electronic circuits. 2. Explain the operation of a basic semiconductor electronic circuit. 3. Calculate the parameters of a basic semiconductor electronic circuit using circuit analysis techniques. 4. Use computer simulation for basic analysis of semiconductor electronic circuits. 5. Prototype basic semiconductor electronic circuits based on a given schematic diagram. 6. Correctly measure basic semiconductor electronic circuit parameters using appropriate equipment. 7. Summarise and report the measured parameter values in commonly used engineering format. 8. Design of basic semiconductor electronic circuits.	1. Define basic computer science theoretical concepts. 2. Design, write, test and debug simple programs written in high-level programming languages. 3. Read and interpret code. 4. Use the language and terminology of object-oriented programming. 5. Summarise and report the algorithm and the coding solution.	1. Solve engineering problems involving key concepts of linear algebra and differential and integral calculus. 2. Use mathematical reasoning and a generalized problem solving process. 3. Use appropriate technology to solve mathematical problems, and judge the reasonableness of the results. 4. Communicate mathematical reasoning and ideas using appropriate language and representations, such as symbols, equations, tables, and graphs.
Ave Weekly Contact	4 hours	5 hours	6 hours	6 hours
Ave Weekly Independent Learning	4 hours	3 hours	2 hours	2 hours
Total Hours (Semester)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)
Assessment	Formative quizzes 30% Final exam 50% Scenario-based role play 20%	Test 1 10% Test 2 10% Practical component 20% Research presentation 5% Project 20% Final exam 35%	Test 1 15% Practical exam 15% Practical component 15% Project – Code review 20% Final exam 35%	Assignment 25% Mid-semester test 30% Final exam 45%
Co-/Pre-requisites	nil	Pre-requisite: Basic Electrical Cuircuits	nil	Pre-requisite: Mathematics 1

Year 2							
Subject Title	**BIOMEDICAL INSTRUMENTATION 1**	**ADVANCED ANALOG ELECTRONICS**	**BIOMEDICAL INSTRUMENTATION 2**	**ENGINEERING SCIENCE**	**PROJECT MANAGEMENT**	**BIOMEDICAL PROJECT**	**EXPOSURE TO ENGINEERING PRACTICE**
Subject Code	ENGBIO601	ENGAEL602	ENGBIO602	ENGSCI601	ENGPMGT601	ENGBPRO601	ENGEXP601
Credit Points	4.5	4.5	4.5	4.5	4.5	4.5	0
EFTSL	0.1248	0.1248	0.1248	0.1248	0.1248	0.1248	0.0032
Topics	Biomedical standards and regulations Electrical safety for medical equipment Clinical equipment	AC Signals review RLC circuits Ideal transformers RLC Filters Active filters Fourier transorm Oscillators Circuit Analysis Differential amplifiers Op-amp integrators Precision rectifiers Single rail operation amplifiers Voltage multipliers Op-amp comparators Phase Locked Loops Structure Operation Design Frequency synthesiser Introduction to feedback control theory Introduction to sensors and actuators	Principles of operation, safety and maintenance of: • Pathology equipment • Dental equipment (including dental chairs and dental surgery equipment) • Medical imaging equipment	Calculus Statics and Dynamics Electricity and magnetism Thermodynamics Semiconductors *Technical report writing.*	Overview of project management Project life-cycle Requirements engineering Risk management and contingencies Scheduling techniques: Preliminary design Engineering documentation Quality management Financial management Performance assessment Communication management Physical Resource management Intellectual property Team leadership Ethical considerations	Design for test and manufacture EMC considerations in circuit design Technology integration in system design *Teamwork skills* *Leadership skills* *Presentation skills* *Technical report writing*	Students are required to complete a portfolio of activities related to Exposure to Engineering Practice. These activities will take place outside normal class time.
Learning Outcomes	1. Explain the operation of biomedical equipment. 2. Apply biomedical and WHS standards and regulations. 3. Fault-find medical equipment used in a clinical setting. 4. Analyse and report on the operation of medical equipment used in a clinical setting. 5. Correctly measure the performance of medical equipment using appropriate tools. 6. Summarise and report the fault-finding results in commonly used engineering format.	1. Define fundamental theoretical concepts as applied in advanced electronic circuits and transducers 2. Explain the operation of advanced electronic circuits and transducers 3. Calculate the parameters of an advanced electronic circuit 4. Use computer simulation for analysis of advanced electronic circuits 5. Prototype advanced electronic circuits with transducers based on a given schematic diagram 6. Correctly measure electronic circuit and transducer parameters using appropriate equipment 7. Summarise and report the measured parameter values in commonly used engineering format 8. Design of advanced electronic circuits	1. Explain the principles of operation, safety and maintenance of pathology, dental and imaging equipment. 2. Apply biomedical and WHS standards and regulations. 3. Apply maintenance and fault-finding techniques to medical equipment used in pathology, dental and imaging settings. 4. Analyse and report on the operation of medical equipment used in pathology, dental and imaging settings. 5. Correctly measure the performance of medical equipment using appropriate tools.	1. Describe calculus techniques related to key concepts of basic physics. 2. Describe units and definitions commonly used in basic physics. 3. Solve scientific problems involving key concepts of basic physics. 4. Communicate mathematical and scientific reasoning and ideas using appropriate scientific language and representations.	1. Define fundamental project management concepts. 2. Define fundamental system integration concepts. 3. Apply project management concepts to the management of small to medium scale projects. 4. Apply system integration concepts to the design and implementation of small to medium scale projects. 5. Produce an engineering project master plan for a small to medium engineering project. The master plan must follow a standard engineering format. 6. Write reports in commonly used engineering format.	1. Apply project management techniques to full life-cycle development of a product. 2. Apply biomedical and engineering design skills to the development of a product. 3. Apply system engineering skills to the development and implementation of a product. 4. Summarise and report in documentation and an oral presentation.	1. Develop an appreciation of the relationship between academic preparation and career expectations. 2. Develop an appreciation of the scope and size of the electronics and biomedical industry in South Australia. 3. Appreciate the responsibilities, roles and work methods of practicing engineering associates in industry. 4. Develop an appreciation of the structure and operation of a company. 5. Appreciate the importance of evaluating their own knowledge and skills capabilities and identifying ongoing professional development and learning needs.
Ave Weekly Contact	6 hours	5 hours	6 hours	5 hours	5 hours	1 hour averaged	3 hours over the whole course
Ave Weekly Independent Learning	2 hours	3 hours	2 hours	3 hours	3 hours	7 hours	93 hours over the whole course
Total Hours (Semester)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	96 hours over the whole course
Assessment Tasks	Test 1 10% Test 2 10% Practical component 40% Final exam 40%	Test 1 10% Test 2 10% Practical component 20% Project 25% Final exam 35%	Test 1 15% Assignment 20% Practical component 30% Final exam 35%	Test 1 15% Test 2 15% Final exam 50% Assignment 20%	Assignment 1 20% Initial project master plan 35% Final exam 35% Assignment 2 10%	Initial project master plan 5% Product (design solution + prototype) 50% Project final documentation set 25% Project presentation 20%	Portfolio of activities 100% Compulsory
Co-/Pre-requisites	Pre-requisites: Electronic Circuits AND Anatomy and Physiology for Biomedical Technologists	Pre-requisites: Electronic Circuits AND Mathematics 2	Pre-requisites: Electronic Circuits AND Anatomy and Physiology for Biomedical Technologists	Pre-requisite: Mathematics 1	Pre-requisite: Students must have gained a minimum of 54 credit points.	Pre-requisite: Students must have gained a minimum of 54 credit points. Co-requisite: Project Management	nil

Electives					
Subject Title	**COMPUTER NETWORKS**	**COMPUTER SCIENCE 2**	**ENGINEERING PRACTICE 2**	**MATHEMATICS 3**	**MICROCONTROLLER PROGRAMMING**
Subject Code	ENGCOMP602	ENGCOMP601	ENGPRAC602	ENGMATH601	ENGMPR601
Credit Points	4.5	4.5	4.5	4.5	4.5
EFTSL	0.1248	0.1248	0.1248	0.1248	0.1248
Topics	Networking fundamentals: Network operating systems: Network security: Cloud networking: Troubleshooting and support.	Revision of basic object-oriented programming concepts Designing with classes Exception handling Inheritance Polymorphism Graphical User Interfaces Fundamental linked data structures and associated computing algorithms *Using Team Communication Skills: Listening and Giving Feedback*	Computer Aided Design tools in engineering • PCB design and manufacture • Introduction to engineering drawings (e.g. AutoCAD) • VHDL • Introduction to Programmable Logic Controllers Computer networks	Linear Algebra Topics: • Eigenvalues and eigenvectors • Vector spaces Rn • Linear Transformation • Series • Linear Algebra applications Calculus Topics: • Appllication of differentiation • Application of integration • Differential equations • Calculus of more than one variable • Taylor series	C Programming for microcontrollers Using I/O ports Interrupts Programmable timers A/D conversions Networking of embedded systems *Teamwork skills: Team Organisation and Leadership*
Learning Outcomes	1. Describe the principles involved in the design and implementation of computer networks. 2. Apply networking theory to design, setup and troubleshoot a wired/wireless local area network. 3. Apply network security principles to secure devices on a computer network. 4. Assess the physical and data access network security of the devices connected to a computer network.	1. Define more advanced computer science theoretical concepts. 2. Design, write, test and debug programs of moderate complexity written in high-level programming language. 3. Implement algorithms based on common algorithmic strategies. 4. Use the language and terminology of object-oriented programming and data abstraction. 5. Summarise and report the algorithm and the coding solution.	1. Use CAD software to lay-out a multi-layer PCB and produce basic engineering drawing. 2. Apply PCB design rules to correctly design the layout of a multi-layer PCB. 3. Describe the basic setup of a wired/wireless local area network. 4. Apply network topology to setup a wired/wireless local area network. 5. Describe issues related to VDHL for FPGAs. 6. Use VHDL to implement a digital sub-system. 7. Describe the basic setup of a PLC system. 8. Apply ladder diagrams to implement a PLC system. 9. Summarise and report project outcomes in written report.	1. Solve engineering problems involving advanced concepts of linear algebra and differential and integral calculus. 2. Use mathematical reasoning and a generalized problem solving process. 3. Use appropriate technology to solve mathematical problems, and judge the reasonableness of the results. 4. Communicate mathematical reasoning and ideas using appropriate language and representations, such as symbols, equations, tables, and graphs.	1. Define theoretical concepts related to the hardware features and the programming of microcontrollers. 2. Design, write, test and debug programs written for microcontroller-based systems. 3. Interface microcontrollers to I/O devices and successfully integrate the hardware with the software. 4. Use the terminology of microcontroller programming. 5. Summarise and report the algorithm, the I/O interface and the coding solution.
Ave Weekly Contact	5 hours	6 hours	5 hours	6 hours	4.5 hours
Ave Weekly Independent Learning	3 hours	2 hours	3 hours	2 hours	3.5 hours
Total Hours (Semester)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)	144 Hours (18 Weeks)
Assessment	Test 1 15% Practical component 20% Project 30% Final exam 35%	Test 1 20% Practical component 20% Project – Code review 25% Final exam 35%	Project (PCB) 25% Project (VHDL) 30% Practical component 20% Test 1 10% Test 2 15%	Assignment 25% Mid-semester test 30% Final exam 45%	Test 1 20% Practical component 20% Project 25% Final exam 35%
Co-/Pre-requisites	Pre-requisites: Digital Electronics OR Computer Science 1	Pre-requisite: Computer Science 1	Pre-requisites: Engineering Practice 1 AND Digital Electronics	Pre-requisite: Mathematics 2	Pre-requisites: (Computer Science 1 OR Computing for Engineering) AND Digital Electronics