



Faculty of Science, Engineering & Health

**Graduate Certificate/Graduate Diploma/Master
of
Railway Signalling and Telecommunications**

**Single non-award Course on Railway
Telecommunications**

Overview of the program

The Central Queensland University is offering a Graduate Certificate/Graduate Diploma/Master degree program in Railway Signalling and Telecommunications as well as a single non-award course on railway telecommunications. The objective of these programs is to facilitate the development of competent railway signalling and railway telecommunications engineers; by providing students with a well-rounded knowledge base, supplemented by relevant work based exercises, to complement employer's graduate development program for new graduates.

The programs also offer an opportunity for those without basic engineering degree qualifications but have extensive work experience in a relevant field to upgrade their academic qualifications.

The Graduate Diploma in Railway Signalling and Telecommunications, which the bulk of students will enrol in, is recognised by the IRSE as acceptable alternative academic qualification for purpose of application for Corporate Membership. This program comprises six courses to be studied in the distance mode – usually as a sequence of one course per term over two years. Students who wish to exit after completing the first three courses will be awarded the Graduate Certificate in Railway Signalling and Telecommunications. Completion of the three third year courses, resulting in the submission of a thesis and passing a thesis defence; will result in the award of the Master degree in Railway Signalling and Telecommunications - which is a qualification in recognition of technical leadership within the profession.

The first intake to this program commenced in 2004 with the first intake in the Master program in 2008.

All course materials for these programs have been developed by the Cooperative Research Centre for Railway Engineering and Technologies (Rail CRC) in collaboration with its industry and university partners, with significant contribution by IRSE (Australasia) members. Central Queensland University has been licensed by the Rail CRC to offer programs using the course materials.

Where appropriate, the program content has been aligned with the Institution of Railway Signal Engineers (IRSE) examination syllabus. In all cases, students learn local practices under the guidance of a work-based mentor as part of work-place activities.

The program will be offered only in distance learning mode using a web-based multi-media online learning platform (Moodle). Students enrolled in the program will develop their professional network and practice their team work skill through assignments and project work in a multi-location team environment (Project-based Learning). Each student is jointly supervised by an academic and an industry-based supervisor (mentor). In addition, a current practitioner of the discipline will be employed as Tutor to guide students through their learning activities.

While people anywhere in the world can undertake this program, the required support arrangement is such that we are only able to accept applicants who can arrange local mentoring support from their employer.

Program goals

The goals of this graduate program in Railway Signalling and Telecommunications are to:

- Develop proficient practitioners in Railway Signalling or provide the base knowledge for Railway Telecommunications
- Meet the requirement for common principles but different applications in each State/Country
- Encourage an understanding of current industry trends and issues
- Encourage development of future industry leaders
- Achieve double certification (University and IRSE)
- Conform to current direction of [professional engineer development framework](#)
- Provide flexible delivery with respect to distance and location of residence
- Encourage work-based and work-relevant learning
- Provide challenging and value adding development to students' capabilities and skills
- Develop students' adaptive, cooperative, and reflective learning ability.

Student Prerequisites

The program is targeted primarily for recent (within 5 years) graduates of Bachelor of Electrical Engineering programs. Candidates who do not meet the above requirements but have at least 5 years of work experience in the appropriate field and show learning maturity and capability may be accepted initially in the Graduate Certificate program on the recommendation (in writing) of their employer.

For acceptance into one of the programs, students must be employed within the railway industry sector and have employer support, including the allocation of a work-based Mentor for the duration of the study period. Candidates whose employer can meet the course support requirements but have difficulties finding a suitably qualified work-based Mentor should contact the Program Coordinator for the appointment of a state-based Mentor.

Entrance requirements for the Master degree are:

- a) Completion of the Diploma in Railway Signalling with a Weighted Grade Point Average of 5.5 or higher. OR,
- b) Completion of the IRSE Examination with a result of four Credits or higher. OR,
- c) Completion of a higher degree and a minimum of five years in the signalling industry, OR
- d) Other qualifications and experience that demonstrate achievement of the fundamental attributes and as may be recommended by the Institution of Railway Signal Engineers industry liaison committee. An interview may be conducted where considered appropriate to determine suitability.

Graduate attributes (Output)

All graduates from the program will have demonstrated the following critical competencies (unconsciously competent):

- Ability to apply safety systems to railway operations in a cost effective manner which contributes to business objectives
- Employ procedures from the safety and reliability assurance tool kit
- Employ procedures from the risk mitigation and management tool kit
- Multi-disciplinary system thinking that can synthesise across social, economical, technical, environmental and legislative issues.

In addition, graduates will have demonstrated through their course work that they have developed the following capability (consciously competent):

- Quickly adapt to any system
- Apply principles to different situations
- Manage interfaces with other disciplines and systems
- Manage projects in design, construction and testing

Furthermore, graduates will have accepted the Institution of Railway Signal Engineers [Code of Professional Conduct](#) and Engineers Australia [Code of Ethics](#) and have demonstrated through the performance of their course work that they have consistently adhered to these Codes.

Mode of Enrolment

All students in this program will enrol in the distance education mode.

Program support

Students will be provided with weekly study guides covering several topics each with recommended reading and workplace activities. In addition to the print-based learning material and a course CD, the distance learning for this program will be supported by a course web site and the following learning support:

- A compulsory 2-day induction program at the commencement of program.
- University based Course Coordinator and Academic Supervisor
- Tele-tutorial (via internet) if required
- Tutor(s) for each course
- Industry-based Mentor for each course
- Course based online discussions and bulletin board facilities (BlackBoard)
- Ad hoc scheduled teleconference (on an as needs basis)

Program structure

The Graduate Diploma in Railway Signalling and Telecommunications program requires completion of 6 of the following 8 courses:

- **RAIL29004 CPD1 Signalling and Safe Railway Operation (Term 1)**
- **RAIL29005 CPD2 Signalling Principles (Term 2)**
- RAIL29006 CPD3 Signalling the Layout (Term 3) or
- RAIL29010 CPD7 Railway Telecommunications (Term 3)
- **RAIL29007 CPD4 Signalling Applications Engineering (Term 1)**
- **RAIL29008 CPD5 Signalling Systems, Management and Engineering (Term 2)**
- RAIL29009 CPD6 Signalling Research/Investigation Project (Term 3) or
- RAIL29023 CPD0 Signalling Professional Competency

The core courses are marked in **BOLD**. Please refer to the [CQU online Handbook](#) for the synopsis of these courses.

The three term year has a total term time of between 42-45 weeks per year. Term 1 is between March-June; Term 2 between July-October; and Term 3 from November-February the following year. Please refer to the CQU [University Academic Calendar](#) for the actual dates of events.

Average weekly learning workload for each candidate is envisaged to be 12 hours private learning time, plus 4 hours of work-based learning activities. The actual time required may vary according to student's current skill base and motivation.

During this time, candidates will develop the following professional capability and skills iteratively:

- Develop railway system and multi-disciplinary perspectives in course 1 (RAIL29004)
- In depth principles of signalling system design in courses 2 and 3 (RAIL29005 & RAIL29006)
- Consideration of equipment design and its influence on system performance in course 4 (RAIL29007)
- Engineering and management practices at system level in course 5 (RAIL29008).
- Develop capability and willingness to find, create, debate, synthesise, extend and communicate discipline knowledge in all courses, with cap-stone projects in course 6 (RAIL29009).

From November 2008 (Term 3), a single non-award course RAIL29010 CPD7 Railway Telecommunications will be offered. This course is intended to help candidates who are employed in the field of railway telecommunications to develop knowledge and skills in the principles and application of railway

telecommunications systems. It is intended that students who successfully completed CPD7 will be offered 8 credit unit of exemption (in lieu of CPD3) in the Signalling program.

The Master of Railway Signalling and Telecommunications program comprises of the following 3 courses:

- RAIL29011 CPD8 Signalling Project Definition and Planning
- RAIL29012 CPD9 Signalling Project Implementation 1
- RAIL29013 CPD10 Signalling Project Implementation 2

Each of these courses can be taken in any of the three terms. The courses must be completed in sequence.

The synopsis of each course is as follows.

RAIL29004 – CPD1 Signalling and Safe Railway Operation

To provide broad, systematic and multidisciplinary knowledge and skills for railway signal engineers and technologists in the role of signalling in safe railway operation and on signalling principles and equipment. This will provide the foundation on which the remaining courses will build. Attention will be focussed on the current business environment of the rail industry and the demand for quality and safety management practices in the delivery of signalling systems.

Topics covered include:

- The current business and legislative environment of the railway industry, including legal requirements and standards in force in the student's own State
- Railway operations, the roles of the engineering disciplines and interface requirements
- Objectives of signalling systems – safety and traffic management efficiency
- History of rail systems and how signalling evolved
- Signalling principles: safe separation of trains, proving and holding the route, failsafe design
- Signals, train detection, points, control panels, level crossing protection: equipment and principles
- Signalling terminology and graphics symbols
- Signal design documents: track plans, control tables, aspect sequence charts, bonding plans
- Automatic Warning Systems, Automatic Train Protection & Automatic Train Operation, their uses and limitations
- Quality control systems and quality management techniques, safety management techniques and AS4292, introduction to safety assurance techniques
- Risk management and quantified risk assessment
- The importance of communication to ensure safety
- Why maintenance is required
- Rules of operation for the safe working of the railway & general rules relevant to signalling / communications, including working under degraded conditions
- Protection of engineering work sites and track safety
- Human factors in the development of signalling systems, operators, maintainers, other railway staff.

RAIL29005 – CPD2 Signalling Principles

To provide a fundamental understanding of Signalling from first principles, and to ensure that students can apply this knowledge in a safe, fit for purpose and cost effective manner. The student must be able to show in their work that the topographical and functional logic, that arises when multiple units of equipment of diverse types are combined, has been taken into account.

Topics covered include:

- Principles of multiple-aspect signalling
- Principles of signalling interlocking systems
- Level crossing controls
- Control tables
- The principles of control of single line railways – all types of manual and automatic systems
- Principles of absolute and permissive working for double lines & block controls
- Automatic Train Protection principles

- Train Detection principles
- Train Control Centres – principles and equipment
- Transmission/radio based signalling principles
- Moving block principles
- Measures to guard against human failure
- Factors affecting the safety, availability, reliability and maintainability of equipment and systems.

RAIL29006 –CPD3 Signalling the Layout

To ensure students can demonstrate that they can signal a layout for a variety of different traffic patterns and equipment systems in a professional and cost effective manner, taking into account the constraints of the layout and safety requirements. Students also need to demonstrate a professional understanding of the integration of the equipment and subsystems used to form the complete signalling system.

Topics covered include:

- The relationship between intensity of traffic, braking characteristics, gradient and the spacing of signals.
- The calculation of time, distance and speed curves
- Headway requirements
- The impact of mixed traffic on line capacity
- Operational factors: maximisation of line capacity, reducing operating costs (cost of braking and accelerating, longer journey times may require more rollingstock but require quantum leaps to take advantage), market advantage with road transport, positioning of crossing points
- Definition of user requirements
- Assessing risk of signalling layouts
- Layouts for level crossing protection
- Principles for investigating incidents involving signalling equipment.

RAIL29007 – CPD4 Signalling Applications Engineering

This course is primarily concerned with equipment at the individual unit, or subsystem level. The student is required to demonstrate a professional understanding of the factors to be considered when applying signalling and communications equipment at all stages in the lifecycle (including research & development), from specification to replacement.

Topics covered include:

- Signalling / Telecommunications principles and railway signalling, control and communications equipment including:
 - Signals Power supplies, cables
 - Point operation and detection
 - Relays and CBIs
 - Hot axle box and other defect detectors
 - Data and incident recorders
 - Lightning protection
- Telecommunications for signalling
- Environmental factors including, traffic type, tunnel and underground environments
- Train Interference Characteristics, Immunisation and Electromagnetic Compatibility
- Installation techniques
- Testing and Commissioning.

RAIL29008 – CPD5 Signalling Systems, Management and Engineering

To ensure the student has a Systems Engineering perspective of the Railway Signalling, Control & Communications system and can provide for the integration of many subsystems and diverse equipment in a professional manner.

Topics covered include:

- Introduction to Systems Engineering concepts

- Design and Operational considerations for failure conditions/ restoration of service
- Human factors in the development of a signalling system
- General phases of a signalling or communications project.
- Whole-of-Life Cost issues
- The different types of specification and their appropriateness
- Contracting/Tendering technology risk
- Quality system and documentation, key areas for system quality and safety checks
- Introduction to safety assurance
- Configuration control
- Hazard, risk & qualified risk assessment, identification and analysis techniques
- FMECA, fault tree analysis
- Relevant Standards
- The advantages and limitations of new technology
- Maintenance.

RAIL29009 – CPD6 Signalling Research/Investigation Project

To continue with students' development of a Systems Engineering perspective of the Railway Signalling, Control & Communications system and to enhance their capability to contribute to the body of professional know-how in Railway Signalling.

On successful completion of this course, students are expected to have produced investigative/research works that are suitable for presentation to IRSE and other professional body technical meetings.

RAIL29010 – CPD7 Railway Telecommunications

To provide broad, systematic knowledge and skills for the application of telecommunications systems in a railway environment. Students will develop a professional understanding of the factors to be considered in applying telecommunications systems and equipment in a railway environment in a safe, fit for purpose and cost effective manner.

Topics covered include:

- The role of telecommunications in the safe operation of railways
- The hazards and associated risks of various types of telecommunications equipment under normal and fault conditions
- Network architecture including bandwidth, bearer selection, backbone vs local
- Transmission systems and equipment: copper, fibre and radio
- Train control requirements and systems
- Human factors in the development of telecommunications systems including user interfaces particularly in times of stress
- Mobile radio systems for train control, maintenance services and shunting, on board equipment
- Telemetry systems for signalling, power supervisory and network control
- Diversity in bearers and equipment
- Fundamentals of good design for safe outcomes
- Management of electromagnetic radiation including immunisation from traction interference
- Power supplies, and earthing
- Cable construction, selection and installation
- Station operations including CCTV, PIDS, emergency phones and PA systems
- Business communications data and voice, linking regional areas to main offices
- Logging equipment, voice recorders and master clocks
- Telecommunications for underground railways.

RAIL29023 – CPD0 Signalling Professional Competency

This course is being offered from 2010 as an elective for CPD6 Signalling Research/Investigation Project. As a Directed Learning Elective, the specific content of the learning for this course will be developed jointly between the employer (represented by the mentor) and CQU (course coordinator) – and to be accepted by the student – and in the form of a learning contract. This learning contract shall specify the professional competencies that the student will need to demonstrate before the end of the course in order to be awarded a pass or better grade; as well as the work assignments and assessment process that could provide evidence of their achievement.

The core competencies that need to be achieved have been specified however there is flexibility for the student to select up to 25% as options. There are four streams of competency:

- Design
- Installation
- Test and commissioning
- Maintenance

Assessment will be by a combination of workplace assessment and professional practice portfolio.

To provide for additional flexibility the course may be commenced at any stage of the Railway Signalling and Telecommunications program.

Citizenship and residency issues

While this program primarily caters for Australian and NZ citizens current employed within the Australasian signalling industry, and residing within Australia, it will be available to Australian and NZ citizens residing outside of Australia. Acceptance will be subject to the applicant meeting entry qualification and employer support requirements.

This program will also be available to non-Australian citizen who holds a long-stay temporary business visa and residing in Australia. Applicants under this category must be in full time employment and meet both the entry qualification and employer support requirements.

Each year a limited number of places will be available for international students provided they meet entry qualifications, English language proficiency and employer support requirements

Fees

The total cost of enrolment will include course tuition fees plus the nominal student service fees as levied by the University. In addition, there will be a compulsory 2-day induction program for participants at the commencement of the program, where all expenses incurred while attending this induction program will be the responsibility of the attendee. These will be explicitly stated in the letter of offer should you be accepted into the program.

The following is indicative information for 2010. The official information is available from <http://studentfinance.cqu.edu.au/FCWViewer/getFile.do?id=29967>

The fee for both domestic and international students is expected to be approximately \$3,200 per course for 2010. There will be a Registration Fee for the 2-day induction program, to be held in Sydney late February (Domestic students only). This charge is required to cover catering and venue hire expenses and is not expected to exceed \$250.

Application

Information related to the program and application forms are available for downloading from the [program web site](#)

Please email either Ken Kwong k.kwong@cqu.edu.au or Les Brearley brearley.les@ansaldo-sts.com.au if the information that you are seeking is not on the program web site.

Information contained in this brochure was correct as of October 2009 but may be subject to changes. Persons intending to act on any information contained herein should first check with CQU to obtain the latest information.