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BACHELOR OF ENGINEERING TECHNOLOGY

CRS1201286

Mechatronics stream

SEMESTER 4 - Mechatronic stream					
5 Mechatronic subjects	**HEETMT401A** Programming Concepts	**HEETMT402A** Mechanical Drive Systems	**HEETMT403A** Design of Fluid Power Engineering Systems	**HEETMT404** Engineering Practice IV	**HEETMT405** Practical Work Placement
PRE-REQUISITE	*HEETCM102A*	*HEETCM101A* *HEETCM301A* *HEETCM303*	*HEETCM102A* *HEETCM302*	*HEETCM102A* *HEETCM302*	**10 SUBJECTS OF STUDY** *HEETCM100*
SEMESTER 5 - Mechatronic stream					
5 Mechatronic subjects	**HEETMT501A** Industrial Project I	**HEETMT502** Fluid Mechanics	**HEETMT503A** Control Systems & Feedback 1	**HEETMT504** Project Management	**HEETMT505A** Advanced PLC
PRE-REQUISITE	*HEETCM100*	*HEETCM100* *HEETCM202A* *HEETCM204A*	*HEETCM102A* *HEETCM202A* *HEETCM204A* *HEETMT401A*	*HEETCM100* *HEETCM101A*	*HEETCM304A* *HEETMT401A*

SEMESTER 6 - Mechatronic stream				
4 Mechatronic subjects	**HEETMT601A** Industrial Project II	**HEETMT602** Quality Management	**HEETMT603A** Control Systems & Feedback 2	**HEETMT604A** Industrial Networking
PRE-REQUISITE	*HEETCM100* *HEETCM101A* *HEETMN501A*	*HEETCM100* *HEETCM101A*	*HEETMT503*	*HEETCM102A* *HEETCM302*

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Mechatronics stream

Semester 4

- HEETMT401A – Programming Concepts
- HEETMT402A – Mechanical Drive Systems
- HEETMT403A – Design of Fluid Power Engineering Systems
- HEETMT404 – Engineering Practice IV
- HEETMT405 – Practical Work Placement

Semester 5

- HEETMT501A – Industrial Project I
- HEETMT502 – Fluid Mechanics
- HEETMT503A – Control Systems and Feedback 1
- HEETMT504 – Project Management
- HEETMT505A – Advanced PLC

Semester 6

- HEETMT601A – Industrial Project II
- HEETMT602 – Quality Management
- HEETMT603A – Control Systems and Feedback 2
- HEETMT604A – Industrial Networking

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Subject information

HEETMT401A – Programming Concepts
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM102A

Subject Lecturer
Hamish Lucas

Synopsis
Programmable computers have long taken the place of tedious, time-consuming manual calculation in engineering practice. The ability to program computers to perform analysis of advanced engineering simulations, control automated systems and to analyse the flow of data to and from industrial processes has become an essential skill for contemporary engineering technologists.

Industry standard software producing digital spread sheets and data files can be interfaced and utilised with the most finely tuned control of industrial processes.

Engineering technologists, in producing calculations and analysis of data, use a base programming language such as C++. A common engineering methodology is to break complex problems into simpler modular elements and use these to solve the main problem. The subject provides the programming underpinnings for more advanced studies in the area.

Outcomes
Upon successful completion of this subject, students should be able to:

(a) Identify and implement programming data types and structured modularised programs.

(b) Construct a design and write iterative programming code.

(c) Apply concepts of programming to engineering problems.

(d) Design graphical programming applications for engineering.

Assessment

- Continuous assessment – 60%
- Final exam – 40% (Hurdle)

Workload requirements
A combination of lectures and tutorials (5 hours per week), and self-directed study (3 hours per week).

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Prescribed and recommended readings
Prescribed reading:

Liberty, J., Rao, S. and Jones, B. (2009) *Sam's Teach Yourself C++ in One Hour a Day* 6th edition. Sam's Publishing, U.S.

Recommended reading:

Current journal articles and useful websites will be made available within the booklist of each subject and revised at the commencement of each cohort of students.

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HEETMN/MT402A – Mechanical Drive Systems
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM101A
HEETCM301A
HEETCM303

Subject Lecturer
Tiong Ha

Synopsis
In the past mechanical drive systems were a limiting factor for achieving higher production, but now due to the improvement of drive component materials, manufacturing techniques, design methodologies, and rating practices, mechanical drive systems are no longer a limiting factor. This subject introduces students to the characteristics of various components used in mechanical drive systems. In particular students are introduced to factors that influence system performance and reliability. A typical mechanical drive system consisting of a gear box, couplings, and bearings can be assembled with different combinations to increase power density and, in turn, increase production. Engineering Technologists are engaged in various production environments. Being able to identify and analyse mechanical drive system performance, efficiency and reliability is essential.

This unit first introduces students to various key mechanical drive system calculations and allied Australian Standards. Students will then study the various mechanical drive components such as; shafts, couplings, brakes and clutches, keys and splines, belt and chain drives, gears, bearings, and their applications. They will also consider the materials used for these components, and appropriate mechanical drive system lubricants.

This subject will be delivered primarily through lectures/tutorials in which students will develop analytical skills in current mechanical drive componentry, their function in the systems, materials used, and lubrications principles.

Outcomes
Upon successful completion of this subject, students should be able to:

(a) Perform mechanical drive system calculations using appropriate formulae.

(b) Use appropriate Australian Standards.

(c) Design drive components for mechanical drive system using catalogues.

(d) Identify factors critical to mechanical drive system performance, efficiency and reliability.

(e) Evaluate the function of a mechanical drive system.

(f) Analyse and specify a mechanical drive system.

(g) Apply lubrication principles for mechanical drive systems.

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Assessment

- Continuous assessment – 70%
- Final exam – 30% (Hurdle)

Workload requirements

A combination of lectures and tutorials (6 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings

Prescribed reading:

Budynas R.G & Nisbett K.J (2014). Shigley's Mechanical Engineering Design (10th Edition). McGraw-Hill

Design Standards for Mechanical Engineering Students SAA HB6 (1999), Standards Australia International

Hosking AQK & Harris MR 2002 Applied Mechanical Design, H & H Publishing

Busby, H.R & Staab G.H (2010). Mechanical Design of Machine Elements and Machines, John Wiley & Sons

Norton RL 2011, Machine Design – An Integrated Approach, Prentice Hall.

Hanbooks:

Erik Oberg et al. 2008, Machinery's handbook 28th Edition. Industrial Press, New York

Kempe's engineers year-book. CMP published, U.K.

E. Avallone et al 2007, Marks' standard handbook for mechanical engineers, McGraw-Hill.

Other:

Journal of Machine Design, http://machinedesign.com

Watson, R 2000, *Mechanical Equipment*, WestOne Services, Perth, Australia

Hibbeler, RC 2009, *Engineering Mechanics: Combined Statics and Dynamics,* 12th edn, Pearson, Australia, ISBN: 9780138149291 (used in Statics and Dynamics)

Recommended reading:

Bhandari, V B2008, *Design of Mechanical Elements*, 2nd edn. Tata McGraw-Hill company Limited, India.

Oberg, H, Jones, FD Horton, HL & Ryffel, HH 2008, *Machinery's Handbook* 28th edn, Industrial Press, New York.

Current journal articles and useful websites will be made available within the booklist of each subject and revised at the commencement of each cohort of students.

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HEETMT403A – Design of Fluid Power Engineering Systems
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM102A
HEETCM302

Subject Lecturer
Marian Tumarkin

Synopsis
Fluid power is an integral part of Manufacturing Processes. It provides multi-function accurate control, high power – low weight ratio, constant force or torque and has numerous safety applications. The rapid convergence of fluid power, microprocessors and computer technology has created unlimited applications of fluid power systems. Smart fluid power systems are becoming the norm rather than the exception.

The aim of this subject is for students to gain an understanding of the concepts and components of fluid power transmission and control in combination with PLC and microprocessor control systems. Students will design, assemble, operate, test and analyse hydraulic, electro-hydraulic, pneumatic, and electro-pneumatic circuits and systems, as well as perform mechanical, hydraulic and pneumatic calculations using MS Excel.

Computer simulation will play an important role at all stages of the learning process. It will assist with understanding, analysis and design of fluid power circuits for sequential and proportional control.

The subject content will focus on, but not be restricted to:

- Principles and parameters of fluid power systems
- Fluid power actuators
- Actuator selection based on specification analysis and mechanical calculations
- Sources of fluid power
- Fluid power control valves
- Fluid power circuit design and analysis. Hydraulic and pneumatic calculations.
- Using computer simulation to analyse and optimise fluid power circuits
- Fluid properties and conditioning
- Electrical/electronic control of fluid power actuators
- Special components of fluid power systems
- Proportional fluid power systems including determination of dynamic response and feedback.
- Using computer simulation to analyse and optimise closed-loop electro-hydraulic and electro-pneumatic systems

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- Installation, maintenance and troubleshooting of fluid power systems
- Installation, maintenance and troubleshooting of fluid power systems
- Instrumentation transducers: pneumatic, hydraulic, pressure, force and strain, level detectors, fluid and gas flow sensors
- Fault finding of instrumentation systems.

Outcomes
Upon successful completion of this subject, students should be able to:

(a) Identify, discuss and classify fluid power components and hydraulic and pneumatic circuits.

(b) Specify the structure of fluid power systems using specification analysis and mechanical calculation.

(c) Design and simulate fluid power circuits and evaluate fluid power components from technical specifications.

(d) Analyse and optimize combinations of hydraulic and/or pneumatic power sections with electrical/electronic sequential control.

(e) Analyse and select components of closed-loop proportional fluid power systems with electronic control and feedback.

(f) Develop, implement and troubleshoot maintenance procedures for fluid power systems.

Assessment

- Continuous assessment – 40%
- Final exam – 60% (Hurdle)

Workload requirements
A combination of lectures and tutorials (4 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings
Prescribed reading:

Cundiff, J.S. (2002) *Fluid Power Circuits and Controls*, CRC Press, New York. ISBN 0-8493-0924-7

Recommended reading:

Casey, B & Tumarkin, M. (2008) *Advanced Hydraulic Control*, HYDRAULIC SUPERMARKET, Perth, Australia.

Current journal articles and useful websites will be made available within the booklist of each subject and revised at the commencement of each cohort of students.

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HEETMT404 – Engineering Practice IV
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM102A
HEETCM302

Subject Lecturer
Ravi Rami

Synopsis
Engineering technologists often need to perform monitoring and testing to ensure the reliability and safety of a functional design.

The engineering technologist needs to be fluent with the advanced operations and configuring of hydraulic and pneumatic systems. Robot interfacing and programming interfacing to other systems is an ever-present function of current automated systems. Often, the robot is interfaced with pneumatic and/or hydraulic systems.

The subject creates the essential practical extension for industrial automation and lays the foundation for the final industrial project. The subject content will focus on:

- Electromechanical system (pneumatics)
- Select and assemble components for activation of pneumatic cylinders
- Reed switches, valves
  - Connect and test assembly
- Electromechanical system (hydraulics)
  - Select and assemble components for activation of hydraulic presses
- Connect and test assembly
- Robot programming
  - PLC control & interfacing to robot I/O
  - Robot pendant & program testing & saving
- Industrial Sensors
  - Capacitive, inductive, photoelectric, acoustic, TDR, LDR interfacing
  - Smart sensors smart limit switch (DeviceNet)
- Electromechanical system
  - Includes pressure, temperature and flow devices
  - Connect test and fault find

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Outcomes

Upon successful completion of this subject, students should be able to:

(a) Specify and connect hydraulic and pneumatic systems.

(b) Design & test robot programs.

(c) Implement control with robot signalling I/O, PLC and touch screen control.

(d) Demonstrate and ability to specify various industrial sensors and their applications and connect and test in simulated industrial applications.

(e) Implement and fault-find electromechanical systems.

Assessment

- Continuous assessment – 100%

Workload requirements

A combination of lectures and tutorials (4 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings

Prescribed reading:

Equipment and Programming manuals.

Chisholm developed class notes pertaining to specific workshop/laboratory equipment.

Recommended reading:

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HEETMN/MT405 – Practical Work Placement
0 credit point

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
10 subjects of study
HEETCM100

Subject Lecturer
Jo Mawdsley

Synopsis
The BEngTech professional accrediting body, Engineers Australia, requires a minimum of eight weeks suitable work experience/practicum during the student's enrolment in the engineering technology degree program. A major requirement of the practicum is that it exposes students to the work of the professional engineering technologist to provide appropriate context for their studies, enable them to better recognise their responsibilities as professional engineering technologists and to further develop their professional attributes.

Chisholm Institute will support BEngTech students in gaining suitable work placements, but students are also free to seek suitable work placements themselves. In addition, mature part time students may already be undertaking suitable employment. In both of these cases students should confirm the suitability of this work experience with the subject chair.

The work placement would normally be taken during the summer break between the 4th and 5th semesters. However there are academic advantages in at least some of this taking place earlier in the student's studies and this is encouraged. Alternative work experience arrangements should be discussed with the subject chair and could include a number of shorter periods of work experience taken throughout the program.

On completion of the eight weeks work placement students are be required to submit a full report on their placement (see assessment 1).

The assessment for this subject is pass or fail, subject to the work experience being satisfactory and the report is of a sufficiently high professional standard.

Outcomes
Upon successful completion of this subject, students should be able to:

(a) Formulate professional reports.

(b) Illustrate a range of professional attributes appropriate to the tasks undertaken in the practicum.

(c) Critically examine the professional responsibilities of engineering technologists.

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Assessment

- Continuous assessment – 40%
- Assessment 5 (Practicum report) – 60%

Workload requirements
A combination of lectures and tutorials (2 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings
Prescribed reading:

On-line access to the *Chisholm CIES Guidelines for the Presentation of Reports* and the *Engineers Australia - Professional Attributes for Engineering Technologists* will be provided.

Recommended reading:

Snooks and Co. (2002) *Style Manual: For Authors, Editors and Printers, 6th edn* John Wiley and Sons, Australia ISBN 0 7016 3648 3

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HEETMN/MT501A – Industrial Project 1
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM100

Subject Lecturer
Amit Krishnan

Synopsis
Industry Project I and II form the capstone of the BEngTech degree program. These two units enable the students to put into practice, through an authentic industry-based engineering technology project, the knowledge and attributes they have developed in the program enabling them to further develop the skill sets they will need as professional engineering technologists. This unit provides direction and support to ensure all students are well prepared for the project they will complete under the guidance of an academic supervisor in Industry Project II. As the project will be carried out in industry an industry liaison person ('industry supervisor' or 'client') will also be appointed to enable access to company facilities necessary for the student to complete the project.

Although every subject in the BEngTech program has potential to provide prerequisite knowledge and skills necessary to support their industry project, the need for students to properly administer their projects through project management tools makes the subject Project Management particularly important as a prerequisite unit.

It is anticipated that the allocation of industrial projects and associated industry and academic supervisors will be made towards the end of semester 5 to enable the student to have time prior to the commencement of semester 6 to visit the company to fully familiarise him/herself with the issues involved in the project through discussion with the academic and industry supervisor.

The subject content will focus on, but not be restricted to:

- A general overview and full open discussion of the requirements of the capstone industrial project
- Productive literature search and review including a tutorial and subsequent individual support from the BEngTech program liaison librarian on search strategies and appropriate journal data bases relevant to the students project
- Developing the final year project report including appropriate formatting and referencing
- An overview of the health and safety assessment requirements and the planning and progress reporting requirements
- Review of oral presentation techniques and strategies
- The engineering design process for innovative, professional and effective outcomes
- Recognise and develop valid methods for competent experimental research

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- Develop, assess and competently use equipment and systems for experimental data acquisition and analysis
- Review of common statistical analysis tools

Outcomes

Upon successful completion of this subject, students should be able to:

(a) Select appropriate project planning tools (critical path analysis, Gantt charts and project loading diagram).
(b) Evaluate the health and safety implications of project implementation and develop health and safety risk mitigation strategies.
(c) Use modern engineering design methods for innovative, professional and effective outcomes.
(d) Critically examine and competently use equipment and systems for experimental data acquisition and analysis.

Assessment

- Continuous assessment – 75%
- Final exam – 25% (Hurdle)

Workload requirements

A combination of lectures and tutorials (3 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings

Prescribed reading:

Gibbings, J.C., Baker, A.G., Dixon, S.L., Drabble, F., Lewkowicz, A.K., Moffat D.G. and Shaw, R. (2009) *The Systematic Experiment: A Guide for Engineers and Industrial Scientists* Cambridge University Press, Cambridge, U.K

Recommended reading:

Snooks and Co. (2002) *Style Manual: For Authors, Editors and Printers, 6th edn* John Wiley and Sons, Australia ISBN 0 7016 3648 3

Leedy, P. and Ormrod, J.E. (2009) *Practical Research: Planning and Design 9th edn* Allyn & Bacon – Pearson Prentice Hall US.

Current journal articles and useful websites will be made available within the booklist of each subject and revised at the commencement of each cohort of students.

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HEETMN/MT502 – Fluid Mechanics
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM100
HEETCM202A
HEETCM204A

Subject Lecturer
Akbar Hessami

Synopsis
Fluid mechanics is a key engineering science in the disciplines of mechanical engineering, mechatronics, chemical engineering, process engineering, aeronautics, astronautics, marine engineering and a number of other engineering disciplines. It is used in such diverse areas as aerospace and automobile aerodynamics, ship performance and stability, pressures and forces on structures, fluidics, pneumatic, hydraulic systems, pipelines, pumps and pumping systems.

The study of fluids and the forces on them, fluid mechanics can be divided into fluid statics (the study of fluids at rest), and fluid dynamics (the study of fluids in motion). Fluids comprise liquids, gases and plasmas. However plasma flow dynamics is a very specialised field and so is not included here.

Fluid mechanics, especially fluid dynamics, is a very active field of research with many unsolved or partly solved problems. As such, the solution to many fluid problems is through experimentally derived empirical equations.

The subject content will focus on, but not be restricted to:

- Properties of fluids
- Introduction to common components such as tanks, pipes and fittings, channels, valves, pumps and turbines, pressure, flow and temperature instrumentation, and actuators.
- Fluid Statics
  - Variation of pressure with depth in a static liquid
  - Pressure measurement
  - Manometry
  - Hydrostatic forces on plane and curved surfaces
  - Buoyancy and Stability of submerged and floating bodies
- Fluid Flow including the equations of continuity and the Bernoulli equation.
- Fluid power
- Fluid Momentum Forces (the momentum equation).
- Physical similarity (physical modelling) and Dimensional Analysis: Reynolds and Froude numbers

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- Lamina and Turbulent Flow through pipes & fittings
- Pipe Networks
- Fluid Machinery including positive displacement pumps
- Centrifugal Pumps and Systems

Note: Reference will also be made to computational fluid dynamics to which they will become exposed in Engineering CAD II.

Outcomes
Upon successful completion of this subject, students should be able to:

(a) Demonstrate sound knowledge of essential fluid mechanics concepts.

(b) Recognise results and calculations in fluid mechanics based on analysis that may contain errors; identify the source and nature of the problem and take corrective action.

(c) Examine laboratory and testing procedures relevant to fluid mechanics.

Assessment

- Continuous assessment – 50%
- Final exam – 50% (Hurdle)

Workload requirements
A combination of lectures and tutorials (4 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings
Prescribed reading:

Douglas, J. F., Gasiorek, J.M., Swaffield, J.A. and Jack, L.B. (2006) *Fluid Mechanics* (5th Edition). Pearson Prentice Hall, Harlow, Essex, U.K.

Recommended reading:

Ward-Smith, J. (2011). *Mechanics of Fluids* (9th Ed). CRC Press.

Current journal articles and useful websites will be made available within the booklist of each subject and revised at the commencement of each cohort of students.

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HEETMT503A – Control Systems and Feedback 1
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM102A
HEETCM202A
HEETCM204A
HEETMT401A

Subject Lecturer
Shou-Han Zhou

Synopsis
Programmable Logic Controllers (PLCs) are an essential component of automation in industry. PLCs are capable of controlling a range of intricate industrial processes, handle mathematical operations and high level commands and function at very high speeds. For the engineering technologist, fluency in PLC operation, interfacing, programming and high-level operations is essential. Advanced PLC programming is a practice oriented project based subject, during the course of the semester students will take on programming and configuration of PLC and HMI interface to fluid or compressed air management training stations.

The subject will extend the student's knowledge of programmable logic controllers, their high-level functions, mathematical operations, connectivity to DeviceNet networks, and fault-finding techniques. The main aim for the students to get exposure to "real world" industrial grade process control systems PLC and HMI program design, testing and commissioning. It will provide substantial underpinning knowledge for the completion of studies in Data Acquisition Systems and Industrial Projects I and II.

The subject content will focus on:

- PLC interfaces and industrial protocol configuration.
- PLC program control
- PLC program structuring
- Data manipulation and memory management
- DeviceNet configuration
  HMI design, programming and interfaces to the PLC and controlled process
- Number systems: binary octal, hexadecimal octal, Binary coded decimals (BCD)
- Mathematical functions
- Analogue input & output
- Scaling input & scaling output
- Proportional integral derivative
- Analyse measurement and control terminology

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- Troubleshooting PLC systems

Outcomes
Upon successful completion of this subject, students should be able to:

(a) Design and program a standard industrial process control system using industry standard equipment.

(b) Set up, configure and interface to industrial sensors and actuators.

(c) Demonstrate the configuration of advanced communication protocols.

(d) Design PLC programs using advanced PLC functions

(e) Construct modularised PLC programs.

(f) Program and configure advanced PLC interfaces for systems and control.

(g) Detect, isolate and categorise complex problems with PLCs

(h) Design and program a Human Machine Interface system using standard industrial SCADA software.

Assessment

- Continuous assessment – 40%
- Final exam – 60% (Hurdle)

Workload requirements
A combination of lectures and tutorials (4 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings
Prescribed reading:

Supplied lecturer notes, tutorials and laboratory manuals material as well as manufacturer specific PLC and instrumentation manuals.

Recommended reading:

Current journal articles and useful websites will be made available within the booklist of each subject and revised at the commencement of each cohort of students.

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HEETMN/MT504 – Project Management
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM100
HEETCM101A

Subject Lecturer
Amit Krishnan

Synopsis
Project management would be most commonly applied in the workplace by the engineering technologist who has responsibility for the supervision of others and may be working in a management role.

It also applies to engineering technologists who are working with a high level of autonomy and alongside managers

Outcomes
Upon successful completion of this subject, students should be able to:

(a) Understand core project management concepts.

(b) Identify core requirements for successful project management in the engineering discipline.

(c) Develop effective project team oriented communication skills and problem-solving skills. Relate the PM Body of Knowledge (PMBOK) to their understanding of the core requirements of successful project management.

(d) Apply essential project management skills and techniques to a given problem scenario.

(e) Appreciate the relationship between project scope, project resources, scheduled time and product quality.

(f) Evaluate the appropriateness of available project selection and project reporting technique.

(g) Maintain well managed relationships with contractor and client organisations through a sound understanding of contract law.

Assessment

- Continuous assessment – 40%
- Final exam – 60% (Hurdle)

Workload requirements
A combination of lectures and tutorials (4 hours per week), and self-directed study (3 hours per week).

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Prescribed and recommended readings
Prescribed reading:

Lock, D. (2007) *Project Management* 9th edn. Gower, Aldershot, U.K. ISBN 978-0-08772-1

Recommended reading:

Smith, N. J. (ed) (2008) *Engineering Project Management*, Wiley-Blackwell ISBN 978-1-40516-802-1,

Kendrick, T. (2009) *Identifying and Managing Project Risk: Essential tools for failure proofing your projects*, 1st edn. AMACOM ISBN 978-0-81441-340-1,

Marmel, E. J. (2009) *In the Trenches with Microsoft Office Project,* Microsoft Press USAISBN 978-0-73562-6164,

Chapman, C. and Ward, S. (2008) *Project Risk Management: Process Techniques and Insights* John Wiley and Sons, Australia ISBN 978-0-470-85355-9

Current journal articles and useful websites will be made available within the booklist of each subject and revised at the commencement of each cohort of students.

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HEETMT505A – Advanced PLC
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM304A
HEETMT401A

Subject Lecturer
Ravi Rami

Synopsis
Programmable Logic Controllers (PLC's) are an essential component of automation in industry. They are used in a wide range of applications from the control and monitoring of single devices to complex industrial processes. They are ideally suited where changes to the system would be expected during its operational life. PLCs have substantial computing power but are specifically designed to withstand industrial environments where noise, dust, temperature etc. may be considerations.

PLCs have extensive Input/Output (I/O) arrangements ranging from a single I/O Module to an array of I/O racks. As well as responding to a range of digital inputs from sensors and switches they can respond to analogue process variables such as temperature and pressure. They very often form part of an industrial communications network operating a Supervisory Control and Data Acquisition (SCADA) system.

Students will familiarise themselves with the operations, programming, interfacing and applications of PLC's and learn effective fault finding strategies and techniques.

The subject provides a foundation in PLC programming, interfacing and applications and provides the underpinning knowledge required for studies in advanced PLC's, data acquisition and the respective industrial projects.

The subject content will focus on:

- PLC Usage in Industry
- Typical Programming Languages
- Ladder Logic, Grafcet, Sequential Function Control (SFC), Text Based
- PLC Types (AB 1500 V5000) (OMRON CSX 1) Shoebox, Micro, Rack
- PLC CPU's and Input & Output
- PLC Wiring
- PLC Communication Interfaces
- Industrial Protocols for PLC's
- Program Editors
- Memory Devices

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- Advanced Logic Concept (Gates)
- Ladder Contact Types
- Timers & Counters
- Control Functions Interlocks & Latches
- Hardware Fault Location & Resetting
- Software Fault Locations and rectification.
- Calibration:
  - tolerances, shock, vibration, environmental variations
  - electrical, frequency, pressure, temperature, dry block
  - software
  - Calibration methods
- Instrument signals
  - Analogue & Digital,
  - Signal quality,
  - Signal conditions

Outcomes

Upon successful completion of this subject, students should be able to:

(a) Demonstrate understanding of programmable logic circuits and ladder diagrams, their interfaces and communication protocols.

(b) Employ connect PLCs to external environments and run functionality tests.

(c) Create and document PLC programs and alter existing programs.

(d) Apply the PLC to a range of industrial applications.

(e) Illustrate error checking skills in PLC hardware and software applications.

Assessment

- Continuous assessment – 60%
- Final exam – 40% (Hurdle)

Workload requirements

A combination of lectures and tutorials (4 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings

Prescribed reading:

Supplied manufacturer specific PLC manuals.

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HEETMN/MT601A – Industrial Project II
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM100
HEETCM101A
HEETMN/MT501A

Subject Lecturer
Akbar Hessami
Brian Carter

Synopsis
Industrial Project II is the capstone of the BEngTech degree program in which students to put into practice, through an authentic industry-based engineering technology project, the knowledge and attributes they have developed in the program. In Industrial Project 1 the preliminary literature review and the project planning (including health and safety risk mitigation) was completed. In this subject the industrial project is implemented with advice and support from the appointed academic supervisor and progress is monitored using the project planning tools developed in Industrial Projects I. Associated with this is the completion of the capstone industrial project report (thesis) and the oral presentation.

This unit is primarily delivered through self-study which will significantly enhance the student's skills in lifelong learning. There are no lectures associated with this subject. Contact hours consist of weekly meetings with the academic supervisor (nominal duration 1 hour) and participation in the final oral presentation seminar including their presentation to an audience of peers, academic staff associated with the program, and invited industry guests. Thus this amounts to an average of 2 contact hours per week for this subject.

Outcomes
Upon successful completion of this subject, students should be able to:

(a) Compare and contrast project management skills.

(b) Employ sound professional report writing skills.

(c) Articulate and present valid methods for competent experimental research.

(d) Select the most appropriate statistical analysis tools for the analysis of experimental results.

Assessment

- Continuous assessment – 100%

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Workload requirements
A combination of lectures and tutorials (2 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings
Prescribed reading:

Gibbings, J.C., Baker, A.G., Dixon, S.L., Drabble, F., Lewkowicz, A.K., Moffat D.G. and Shaw, R. (2009) *The Systematic Experiment: A Guide for Engineers and Industrial Scientists* Cambridge University Press, Cambridge, U.K.(as prescribed in Industrial Projects I)

Recommended reading:

Snooks and Co. (2002) *Style Manual: For Authors, Editors and Printers, 6th Edn* John Wiley and Sons, Australia ISBN 0 7016 3648 3

Leedy, P. and Ormrod, J.E. (2009) *Practical Research: Planning and Design 9th Edn* Allyn & Bacon – Pearson Prentice Hall US.

Current journal articles and useful websites will be made available within the booklist of each subject and revised at the commencement of each cohort of students.

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HEETMN/MT602 – Quality Management
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM100
HEETCM101A

Subject Lecturer
Brian Carter

Synopsis
Recently manufacturing in high wage economies has suffered significantly increased competition in direct high volume manufacturing from low wage economies and a trend by western (and Japanese) manufacturers to reduce manufacturing costs through outsourcing part or all of their manufacturing to low wage countries. Quality as a marketing differentiator, along with automation and lean manufacturing to reducing manufacturing costs, is increasingly acknowledged by high wage economies such as Australia as providing the best path to manufacturing survival.

Whilst earlier quality initiatives such as Quality Circles focused on shop floor involvement, more recent quality initiatives in manufacturing, such as six sigma, are more technologically advanced, demanding the involvement of more technologically skilled people such as engineers and engineering technologists.

The subject content will focus on, but not be restricted to:

- The Historical Development of Quality Management:– Industrial Standardisation, Taylor's Scientific Management, Ford, Shewhart – the Shewhart Cycle, Deming, The Toyota Production System, Crosby
- Defining Quality – Managing Error.
- Customer Focus – 'Voice of the Customer'.
- Key Quality Concepts
- Statistical Process Control
- Quality Circles
- Total Quality Management
  - TQM Tools and Techniques
- Six Sigma
  - Six Sigma Tools and Techniques
- Introduction to ISO 9000
- The cost of quality
- Practical Quality Management
- Quality Management for Projects

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Outcomes

Upon successful completion of this subject, students should be able to:

a) Apply the key tools and techniques of quality management.
b) Critically examine the contribution of the key thinkers in the historical development of quality management to modern quality management principles.
c) Examine the tools and contributions of the various quality movements to modern quality management practices: Quality Circles, Total Quality Management, ISO 9000 and Six Sigma.
d) Appraise quality management focused manufacturing environment requirements.

Assessment

- Continuous assessment – 50%
- Final exam – 50% (Hurdle)

Workload requirements

A combination of lectures and tutorials (3 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings

Prescribed reading:

Kemp, S. (2006) *Quality Management Demystified*, McGraw-Hill, N.Y. USA ISBN: 0-07-144908-6

Recommended reading:

James R. Evans, William M. Lindsay (2005), Western "THE MANAGEMENT AND CONTROL OF QUALITY"6th Edition, Thomson South ISBN: 0-324-22503-2, book and CD.

Dale H. Besterfield (1995), "Quality Control"4th edition. Prentice Hall Career & Technology Prentice Hall Inc.ISBN 0-13-501115-9

Pyzdeh, T. and Keller, P (2009) *The Six Sigma Handbook* 3rd edition. McGraw-Hill, N.Y. USA ISBN: 978-0-07-162338-4

Cygi, C and DeCarlo, N. (2005) *Six Sigma for Dummies* Wiley, Indianapolis, Indiana. USA ISBN: 0-7645-6798-5.

Liker, J. (2004) *The Toyota Way*, McGraw-Hill, N.Y. USA ISBN: 0-07-139231-9

Hoyle, D. (2009) *ISO 9000 Quality Systems Handbook* 6th edition. Elsevier, Oxford, UK ISBN: 978-1-85617-684-2.

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HEETMT603A – Control Systems and Feedback 2
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETMT503

Subject Lecturer
Shou-Han Zhou

Synopsis
Programmable Logic Controllers (PLCs) are an essential component of automation in industry. PLCs are capable of controlling a range of intricate industrial processes, handle mathematical operations and high level commands and function at very high speeds, For the engineering technologist, fluency in PLC operation, interfacing, programming and high-level operations is essential. Advanced PLC programming is a practice oriented project based subject, during the course of the semester students will take on programming and configuration of PLC and HMI interface to fluid or compressed air management training stations.

The subject will extend the student's knowledge of programmable logic controllers, their high-level functions, mathematical operations, connectivity to DeviceNet networks, and fault-finding techniques. The main aim for the students to get exposure to "real world" industrial grade process control systems PLC and HMI program design, testing and commissioning. It will provide substantial underpinning knowledge for the completion of studies in Data Acquisition Systems and Industrial Projects I and II.

The subject content will focus on:

- PLC interfaces and industrial protocol configuration.
- PLC program control
- PLC program structuring
- Data manipulation and memory management
- DeviceNet configuration
  HMI design, programming and interfaces to the PLC and controlled process
- Number systems: binary octal, hexadecimal octal, Binary coded decimals (BCD)
- Mathematical functions
- Analogue input & output
- Scaling input & scaling output
- Proportional integral derivative
- Analyse measurement and control terminology
- Troubleshooting PLC systems

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Outcomes

Upon successful completion of this subject, students should be able to:

a) Design and program a standard industrial process control system using industry standard equipment.

b) Set up, configure and interface to industrial sensors and actuators.

c) Demonstrate the configuration of advanced communication protocols

d) Design PLC programs using advanced PLC functions

e) Construct modularised PLC programs.

f) Program and configure advanced PLC interfaces for systems and control

g) Detect, isolate and categorise complex problems with PLCs

h) Design and program a Human Machine Interface system using standard industrial SCADA software.

Assessment

- Continuous assessment – 100%

Workload requirements

A combination of lectures and tutorials (4 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings

Prescribed reading:

Supplied lecturer notes, tutorials and laboratory manuals material as well as manufacturer specific PLC and instrumentation manuals.

Recommended reading:

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HEETMT604A – Industrial Networking
11 credit points

Offering(s)
Semester 1 & Semester 2 (On-campus)

Prerequisites
HEETCM102A
HEETCM302

Subject Lecturer
Ravi Rami

Synopsis
Industrial Communication is important in industry as data for monitoring and control functions is critical for effective system operation. Engineering technologists must be proficient with many industrial communication protocols as well as their respective interfacing. Effective industrial communication is critical in safety, fault monitoring and breakdown minimisation.

The subject will emphasise the modern aspects of industrial communications such as the Internet and wireless access. This subject creates the essential background for the capstone Industrial Project as well as integrated areas of study with Advanced PLC and Data Acquisition Systems.

The subject content will focus on:

- Data Communication systems
- International Standards Organisation (ISO)/Open System Organisation (OSI)
- Seven layer Model of Communications
- Communication Cabling
- Copper, coaxial, unshielded twisted pair (UTP), shielded twisted pair (STP), fibre optic
- Communication soft wire
- Microwave, radio wave, infrared, laser
- Network Topology
- Star, bus, mesh, ring, tree
- Network Infrastructure
- Routers, switches, repeaters, servers,
- Industrial Protocols
- Common industrial protocol (CIP), Transmission control protocol (TCP)/Internet protocol (IP)
- RS232C, RS422, data highway, Ethernet, DeviceNet, canbus, contronet, asi, flnet
- TCP/IP Fundamentals
- Carrier Sense Multiple Access (CSMA)/Collision Detection (CD), classes, subnetting, scoping, DNS, DHCP, BOOTP

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- DeviceNet Fundamentals
- CSMA/Non bitwise arbitration (NBA) id's termination, programming
- Supervisory control and data acquisition (SCADA)
- Communication programming & configurations
- Touch Screens
- Communication programming & configurations
- Internet access to industrial communication equipment
- PLC's, touch screens,
- Wireless communication
- Interfacing industrial equipment
- Alarms & logging
- Trouble shooting industrial communication systems

Outcomes
Upon successful completion of this subject, students should be able to:

a) Design an industrial communications network.
b) Analyse and fault find typical industrial networks and interfaces.
c) Summarise typical protocols and components of an industrial network.
d) Configure and construct industrial communication infrastructure and equipment.

Assessment

- Continuous assessment – 70%
- Final exam – 30% (Hurdle)

Workload requirements
A combination of lectures and tutorials (3 hours per week), and self-directed study (3 hours per week).

Prescribed and recommended readings
Prescribed reading:

Reynders, D., MacKay, S. and Wright, E. (2005) *Practical Industrial Data Communications Best Practice Techniques* Oxford, UK.

Recommended reading:

Current journal articles and useful websites will be made available within the booklist of each subject and revised at the commencement of each cohort of students.