UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Term 2 2019

MANF3510

PROCESS TECHNOLOGY AND AUTOMATION

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1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Erik van Voorthuysen
Office Location: Ainsworth Building (J17), Room 507
Telephone: 9385 4147
Email: erikv@unsw.edu.au

Name: Dr Ronald Chan
Office Location: Ainsworth Building (J17), Room 507
Telephone: 9385 5135
Email: r.chan@unsw.edu.au

Consultation concerning this course is available immediately after the classes. Face-to-face consultation is preferred.

Contact details and consultation times for additional lecturers/demonstrators/lab staff

Please see the course Moodle.

2. Important links

- Moodle
- Lab Access
- Computing Facilities
- Student Resources
- Course Outlines
- Engineering Student Support Services Centre
- Makerspace
- UNSW Timetable
- UNSW Handbook
- UNSW Mechanical and Manufacturing Engineering

3. Course details

Credit points

This is a 6 unit-of-credit (UoC) course and involves 4 hours per week (h/w) of face-to-face contact.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

You should aim to spend about 15 h/w on this course. The additional time should be spent in

making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

Contact hours

	Day	**Time**	**Location**
Lecture	Thursday	1400 - 1600	Red Centre M032
Lab	Thursday	1600 - 1730	Undergraduate Teaching Lab 116A

Please refer to your class timetable for the learning activities you are enrolled in and attend only those classes.

Summary and Aims of the course

Key factors for success in modern manufacturing include quality, productivity, efficiency, flexibility, agility, and customer satisfaction all while maintaining control over cost. Depending on the characteristics of the product and its market, an appropriate manufacturing process needs to be designed. This course is closely aligned with the characteristics and requirements of small to medium scale manufacturing, entrepreneurial start-ups and prototyping.

MANF3510 builds on knowledge gained in MANF3100 Product and Manufacturing Design, where the aim is to develop a design or prototype into a product that can be successfully manufactured. MANF3510 takes this concept to the next stage through teaching you how to design a manufacturing process by specifying, selecting and integrating the basic building blocks of process technology and automation into a successful manufacturing process or machine. The course contains appropriate theory and also focuses on the required practical knowledge to be able to put this theory into practice.

The course covers the basic technology and elements used to design computerised and automated manufacturing systems. It deals with the principles of numerically controlled machine tools and their elements, from basic machines to the level of sophisticated turning and machining centres. It then covers in more detail, assisted by practical examples and assignments, the procedure of CNC manufacturing, selection of machine elements and their control, particularly using programmable logic controllers (PLC). An integral part of the course is the ability to integrate computer-aided design (CAD) with computer-aided manufacturing (CAM).

Course material and topics include design methods and aids for selecting and integrating technology and equipment items into high performance machines, as well as a thorough understanding of the individual building blocks including actuators, sensors, structural elements, power transmission, controllers, communication, operator interfaces and support systems.

Topics include:

- Function and control of CNC machine tools
- Sensors and actuators in automated systems
- Programming of CNC machine tools and PLCs
- Design and integration of machine elements
- Programmable logic controllers
- CAD/CAM principles and programming (SolidWorks and SolidCam)

This course includes a substantial amount of laboratory work in order to gain a deeper understanding of the discipline of machine design and operation.

The course will combine lectures with practical case studies that require the theory taught to be applied to actual machine systems.

The course aims to develop you into a skilled and all-rounded process design engineer able to carry out and manage the key design processes in parallel and concurrently. Design is inherently complex and a systematic, yet flexible, agile and interdisciplinary approach is required to bring product to the market successfully and in less time, using appropriate technology. The course teaches this approach - based on global best-practice methodologies and industry lecturers - and incorporates case studies and projects to apply these methodologies and become proficient at them.

Student learning outcomes

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning Outcome		**EA Stage 1 Competencies**
1.	Understand and apply systematic design principles as part of designing automated industrial machines and processes.	PE1.3, PE1.5, PE2.1, PE2.3
2.	Use appropriate CAD/CAM technology to design a component and generate the CNC code to manufacture that component using CNC and/or 3D rapid prototyping manufacturing technology.	PE1.3, PE2.2, PE2.3, PE3.4
3.	Understand the performance and characteristics of major machine elements and building blocks and how to specify and select appropriate equipment items from suppliers.	PE1.1, PE1.3
4.	Be able to integrate the various elements of automation into an appropriate machine or process.	PE2.1, PE2.2, PE2.3

4. Teaching strategies

Lectures in the course are designed to cover the terminology and core concepts and theories in the area of manufacturing process design. They do not simply reiterate the texts, but build on the lecture topics using examples taken directly from industry to show how the theory is applied in practice and the details of when, where and how it should be applied.

This course will combine lectures with case studies and real-life designs. The material will be presented in the lecture and the student is expected to actively participate in discussion, analysis and design. Assignments to develop the understanding of the key methodologies and theories and how to apply them will be provided as part of the course. There will be quizzes to support the learning experience, and in addition, there will be a final exam.

The lectures cover the underlying theory and key methodologies centered on process design, CNC manufacturing, PLC control and machine element selection. These methodologies are state-of-the-art and used by leading industrials. The assignments are designed to use these methodologies on real case studies and give you the confidence and ability to make important design and manufacturing decisions to help prepare you for a rewarding career in this field.

5. Course schedule

Week	Lecture Topic	Lab/Quiz
1	Introduction to Automation Technology and the Internet of Things, Industry 4.0	Lab Introduction
2	Computer Hardware, Controllers, Sensors, Binary Theory	Install Omron Software on Student PCs.
3	Programmable Logic Controllers (PLC) – Part 1, Boolean Logic	PLC Basics 1
4	Programmable Logic Controllers (PLC) – Part 2	PLC Intermediate Exercises
5	Introduction to Computer Aided Manufacturing (CAM), 3D CNC Machining Operations using Autodesk Fusion360 – Part 1	Quiz1: Control, sensing, technology, PLCs. PLC Advanced Exercises
6	3D CNC Machining Operations using Autodesk Fusion360 – Part 2	PLC Assignment Support
7	Machine and Systems Design and Analysis, Machining Variables	PLC Assignment Support

Week	Lecture Topic	Lab/Quiz
8	Industrial Robotics	PLC Assignment Viva Assessment
9	Structural Elements, Actuators and Motors	Introduction to Fusion360 and Denford CAM software
10	Pneumatics	CNC Assignment Support Quiz 2: CNC, CAM, Robotics and Automation Technology
11	CNC Machine Assignment Viva Assessment	

6. Assessment

Assessment overview

Assessment	Group Project? (# Students per group)	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Group assignment	Yes (3)	30 mins VIVA	40%	1, 2, 3 and 4	Technical content, Programming skill, Costing, Design capability, Professional communication and report writing skills	Week 8 and 10	One week after due date	On-the-spot Feedback
Quizzes	No	1 hour	20%	1, 2, 3 and 4	Lecture material from weeks 1 to 5 (Quiz 1) Lecture material from weeks 6 to 9 (Quiz 2)	Week 4 and 10	N/A	One week after submission
Final exam	No	2 hours	40%	1, 2, 3 and 4	All course content from weeks 1-10 inclusive.	Exam period, date TBC	N/A	Upon release of final results

Assignments

Full requirements for Assignment Part 1 and Part 2 will be placed on Moodle. Assistance for the assignment will be provided during allocated tutorial sessions. The assignments are to be undertaken as a group. The assignments will cover two important areas of manufacturing, namely programming of the most common control platform in industry - the programmable logic controller (PLC) - and the design and realisation of your design using CNC technology.

Both parts of the assignment involve a compulsory practical demonstration. For the PLC assignment, you will demonstrate your group's functional PLC project, where it will be subjected to a series of tests and group members will be asked verbal questions. For the CNC assignment, you will have the opportunity to mill your design (if it is able to be milled) on the CNC milling machine and verbal questions will be asked of group members. All group members must attend the demonstration, and the demonstration will contribute to your mark for the assignment. Multiple days will be available for the demonstration, including times during the timetabled tutorial class.

For the written submission, you need to ensure that you use an appropriate writing style as well as professional formatting and content in your report. The assignments support the learning outcomes by incorporating an appropriate mix of analytical techniques, enabling software, data analysis that supports achievement of appropriate solutions.

Presentation

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Submission

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 percent (20%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.

Work submitted after the 'deadline for absolute fail' is not accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

a. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
b. Online quizzes where answers are released to students on completion, or

c. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
d. Pass/Fail assessment tasks.

Marking

The following criteria will be used to grade assignments:

- Analysis and evaluation of requirements by integrating knowledge and methods learned in lectures and demonstrations
- Sentences in clear and plain English—this includes correct grammar, spelling and punctuation
- Correct referencing in accordance with the prescribed citation and style guide
- Appropriateness of engineering techniques and methodologies used
- Accuracy of numerical answers and comprehensiveness of methods and techniques employed
- Evidence of quality data and analysis-based decision making
- All working shown
- Use of diagrams, where appropriate, to support or illustrate the calculations
- Use of graphs, where appropriate, to support or illustrate the calculations
- Use of tables, where appropriate, to support or shorten the calculations
- Neatness
- Professional nature of verbal presentation during the practical demonstration
- Technical quality of your work seen during the practical demonstration

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Examinations

Part of the assessment includes two quizzes (10% each) and a final exam. The quizzes are designed to assist the learning and understanding of the underlying theory of the course and to help prepare you for the final exam. All questions in the quizzes and exam will require either short written answers or analysis and calculations or both. Tutorial problems will also be provided.

You must be available for all tests and examinations. Final examinations for each course are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates.

For further information on exams, please see the Exams webpage.

Calculators

You will need to provide your own calculator of a make and model approved by UNSW for the examinations. The list of approved calculators is available at

student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an "Approved" sticker for it from the Engineering Student Supper Services Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to submitting an assessment or sitting an exam.

Please note that UNSW now has a Fit to Sit / Submit rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

7. Expected resources for students

Lecture notes for all topics will be posted on Moodle. For all e-Books and reference books please visit the UNSW Library website: https://www.library.unsw.edu.au/

Textbooks

Industrial Automation – Hands-on, Frank Lamb, 2013, McGraw Hill.

This textbook is available through the bookstore at UNSW and a copy will be put into the 'High-Use Collection' section of our library.

Reference books

1. Manufacturing Process Selection Handbook: From Design to Manufacture, Swift K.G., Booker J.D., 2013, Burlington, Elsevier Science, ISBN 9780080993607 – available from our library electronically.
2. Applied Metrology for Manufacturing Engineering, Grous A, 2011, ISTE, John Wiley & Sons, Inc, ISBN 9781848211889.
3. Low-cost Jigs, Fixtures & Gages, for limited production, Boyes W.E. ed., Society of Manufacturing Engineers, 1986, Dearborn, Michigan.
4. Fundamentals of Modern Manufacturing, Groover M.P., 2nd ed., 2002 John Wiley.

UNSW Library website: https://www.library.unsw.edu.au/
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

8. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include a more streamlined CNC assignment and a recently redesigned PLC "machine-on-a-board" test rig.

9. Academic honesty and plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here:
www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

10. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Computing Facilities
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Student Equity and Disabilities Unit
- Health and Safety
- Lab Access

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership