UNSW AUSTRALIA

Course Outline

Semester 2 2015

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

MANF3510

PROCESS TECHNOLOGY AND AUTOMATION

Contents

1. Staff Contact Details

Contact details and consultation times for course convenor and lecturers

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Consultation concerning this course is available immediately after the classes. Direct consultation is preferred.

2. Course details

Credit Points:

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

The UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week.”

This means that you should aim to spend about 9 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**
Lectures	Monday	2 - 4pm	ASB130
Demonstrations (start in week 2)	Monday	4 – 5pm	Mech Eng Room 203
	Wednesday	10 – 11am	ASB106

Summary 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 by 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 but 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 centers. 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.

Aims of the Course

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, 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 below learning outcomes 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 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
5.	Understand the capability and performance of off-the-shelf programmable logic controllers and be able to write and execute basic ladder programming of these devices.	PE1.3, PE2.2
6.	Understand the role of safety and regulatory compliance of machine design.	PE3.1, PE3.4

3. 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.

Lab sessions are designed to provide you with feedback and discussion on the assignments, and to investigate problem areas in greater depth to ensure that you understand the application.

Teaching Strategies and their rationale

This course will be presented using PowerPoint presentations as well as 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.

Suggested approaches to learning in the course

Suggested approaches to learning in this course include:

- Careful reading, discussion and understanding of the material presented in lectures.
- Additional reading on and about the material presented in lectures to broaden the knowledge base.
- Paying attention throughout the lectures/demonstrations, and asking questions when anything is not understood.
- Conscientiously working through assignments.
- Learning of the lecture material in preparation for quizzes.

Student-centered and self-directed learning (expectations of the students)

This course involves four hours per week of face-to-face contact, and it is expected that you will put in, on average, an additional five to six hours per week of your own time. This time should be spent in revising lecture material and further reading, completing assignments, and revising and learning for the quizzes.

Expected learning outcomes; their association with the teaching strategies and with the suggested approaches to learning

The lectures are designed to teach you 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. This helps to prepare you for a rewarding career in this field.

The course has been designed to support academic learning, by understanding the theory and philosophy of design for manufacturing, but also to support developing practical skills that industry needs.

4. Course schedule

Week	Topic
1	Introduction to Process Automation and Technology
	No lab in week 1
2	Design and Control of CNC Machines, ISO code
	Assignment 1: CNC Machining
3	Machine and System Design
	Lab: CNC Machining
4	Structural and Machine Elements, Machine Mechanisms
	Lab: CNC Machining
5	Sensors, Controllers, Programmable Logic Controllers 1
	Lab: CNC Machining
6	Programmable Logic Controllers 2, Communications
	Assignment 2: PLC Programming
7	Power, Cabling, Actuators and Motors
	Lab: PLC Programming
8	Pneumatics
	Lab: PLC Programming
9	Standards, Regulations, Safety
	Quiz 1: CNC Manufacturing
10	Machine Systems
	Lab: Actuators, Sensors and Control
11	HMI, SCADA, Data Acquisition
	Lab: Actuators, Sensors and Control
12	Integration and Commissioning
	Quiz 2: Machine Elements, Systems and Control
13	Course Overview

5. Assessment

Assessment task	Topic	Weight	Learning outcomes assessed	Assessment criteria	Due date, time, and submission requirements
Group Assignment I	CAD/CAM	20%	2	Technical content, design capability and report writing skills	End of week 8 via Moodle
Group Assignment II	PLC	20%	5 and 6	Technical content, Programming skill and report writing skills	End of week 13 via Moodle
Quiz 1	CNC and Automation Technology	10%	1, 2 and 3	Understanding of lecture material and theory	Week 6 TBC
Quiz 2	Control and sensing technology, Design and Safety	10%	4, 5 and 6	Understanding of lecture material and theory	Week 11 TBC
Final exam	2 hours	40%	1, 2, 3, 4, 5 and 6	All course content from weeks 1-12	Exam period, date TBC

Assignment and quiz details will be posted on Moodle at the appropriate times.

Assignments

Presentation

All submissions should have a standard School cover sheet which is available from this subject's Moodle page.

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

Submission

Each of you will undertake two assignments. You can undertake this by yourself or in a team of two. The assignments will cover two important areas of manufacturing, namely the design

and realisation of your design using CNC technology and the programming of the most common control platform in industry, the programmable logic controller or PLC.

Each part of the assignment requires a write-up and these are due in week 8 and week 13.

You need to ensure that you use both an appropriate writing style as well as professional formatting and editing of style and content in your report.

Completed assignments will be handed in hard copy by the end of the week the assignment is due. The assignments support the learning outcomes by incorporating an appropriate mix of analytical techniques, enabling software, data analysis that supports achievement of appropriate solutions.

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor ***before the due date***. Special consideration for assessment tasks of 20% or greater must be processed through https://student.unsw.edu.au/special-consideration.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Assessment Criteria

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 correctness of code or control program
- 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, were appropriate, to support or illustrate the calculations
- Use of tables, where appropriate, to support or shorten the calculations
- Neatness

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. Demonstration 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, which are June for Semester 1 and November for Semester 2.

Provisional Examination timetables are generally published on myUNSW in May for Semester 1 and September for Semester 2

For further information on exams, please see Administrative Matters.

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 shown at https://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 School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special Consideration and Supplementary Assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see Administrative Matters, available on the School website and on Moodle, and the information on UNSW's Special Consideration page.

6. Expected Resources for students

Textbooks:

1. 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

Additional information may be available from the UNSW Library website: https://www.library.unsw.edu.au/servicesfor/index.html

7. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) 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.

Recent improvements to this course include the introduction of SolidCam and a greater emphasis on scalable production systems.

8. 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: https://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:
http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is presented in a School handout, Administrative Matters, available on the School website.

9. Administrative Matters

You are expected to have read and be familiar with *Administrative Matters*, available on the School website: https://www.engineering.unsw.edu.au/mechanical-engineering/sites/mech/files/u41/S2-2015-Administrative-Matters_20150721.pdf

This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

Erik van Voorthuysen
July, 2015

Appendix A: Engineers Australia (EA) Professional Engineer Competency Standards

	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