UNSW AUSTRALIA

Course outline

Semester 1 2017

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

MANF4100

DESIGN AND ANALYSIS OF PRODUCT-PROCESS SYSTEMS

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Ronald Chan
Office location: J17, room 507
Tel: (02) 9385 1535
Email: r.chan@unsw.edu.au

Consultation for this course is available immediately after each lecture. For additional consultation, please make an appointment with the staff by email.

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

Name: Dr Erik van Voorthuysen
Office location: J17, room 507
Tel: (02) 9385 4147
Email: erikv@unsw.edu.au

Consultation for this course is available immediately after each lecture. For additional consultation, please make an appointment with the staff by email.

2. Course details

Credit Points

This is a 6 unit-of-credit (UoC) course, and involves 3 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	Tuesday	11am – 1pm	Ainsworth 102
Demonstrations	Monday	1pm – 2pm	Ainsworth 102

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 system needs to be designed, integrating appropriate manufacturing processes, machinery, automation, materials handling and management systems. This course is closely aligned with the characteristics and requirements of small to medium scale manufacturing, entrepreneurial start-ups and prototyping.

MANF4100 integrates the theory and knowledge gained from MANF3100 Product and Manufacturing Design and MANF3510 Process Technology and Automation into the theory and practice of designing and analysing automated and computer integrated manufacturing and product-process systems and facilities. The design of such systems is complex and needs to consider multiple factors and design drivers, including the nature and characteristics of the product, the market, the manufacturing breadth and scope of the organisation, the appropriate level of manufacturing flexibility, manufacturing and materials handling technology as well as demographic characteristics such as workforce skills, labour rates and environmental factors. The performance of such systems needs to be understood in the early stages of concurrent product-process design and continuously adapted and improved as the needs and requirements change throughout the product (and process) life cycle.

The course is focused on design as well as analysis. It covers essential analytical techniques involved in understanding and planning manufacturing requirements and translating these into feasible manufacturing system design alternatives. The course requires a solid prior understanding of product design for manufacturing as well as automation technology.

Topics include:

- Different types of Product-Process systems and their application
- Technical and economic factors in designing flexible, modular and scalable systems
- Manufacturing strategies and ongoing improvement strategies and methodologies
- Capacity planning
- Factory layout design
- Resource allocation using linear programming
- Inventory management, production planning and scheduling
- Human factors

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

Aims of the course

The course aims to develop you into a skilled and all-rounded process, manufacturing, factory and industrial 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 and operations management. The course teaches this approach, at the manufacturing system and factory level, 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 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 manufacturing systems and factories.	PE1.1, PE1.5, PE1.6
2.	Use appropriate analytical techniques, including Linear Programming to plan, specify and design a manufacturing system or, for that matter, a business process.	PE1.1, PE2.2, PE2.3
3.	Understand data and information flow within a factory system and how this affects decision making, efficiency and effectiveness of the manufacturing operation.	PE1.1, PE1.2, PE2.1
4.	Understand, implement and manage key manufacturing improvement strategies including lean manufacturing.	PE2.4, PE3.2, PE3.3

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.

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 online quizzes to support the learning experience, and there will be a final exam.

4. Course schedule

Date	Topic	Lecture Content
28/02/17 (Week 1)	Introduction to Product-Process Systems	• Global Manufacturing Issues • Comparison of Manufacturing Sectors • Competitive Strategy • Push – Pull Systems • Volume – Variety • Productivity – Flexibility • Global – Local Manufacturing • Product-Process Matrix • Production Process Strategies
07/03/17 (Week 2)	Key Process Drivers for Successful Process	• Flexibility • Reliability • Agility • Scalability • Economic Factors • Sustainable Manufacturing • Line Balancing
14/03/17 (Week 3)	Process Design and Analysis	• Time Horizon in Capacity Planning • Design – Effective Capacity, Capacity Utilisation and Efficiency • Analysis of Flow and Throughput Rate • Bottleneck Analysis and the Theory of Constraints • Breakeven Analysis, Cost-Volume Analysis
21/03/17 (Week 4)	Forecasting Techniques	• Forecasting Time Horizons • Types of Forecasts • The Forecasting Process • Time Series Forecasting • Moving Average • Exponential Smoothing • Measuring Forecasting Error • Trend Adjustment • Seasonal Variation • Regression Analysis
28/03/17 (Week 5)	Factory Layout Planning & Factory Location Selection	• Strategic Importance of Layout Decisions • Types of Layout • Process Layout Cost Calculation • Product Layout • The Economics of Transportation • Factor Rating Method • Centre of Gravity Method
04/04/17 (Week 6)	Human Factors and Job Design	• Labour Planning • Job Design • Ergonomics • Statistical Methods Analysis and Time Studies
11/04/17 (Week 7)	Resource Allocation – Linear Programming 1	• Formulating an LP problem • Simplex Method • Geometry of the Simplex Method • Using Microsoft Excel Solver
25/04/17 (Week 8)	Public Holiday	

02/05/17 (Week 9)	Transportation Models	• Formulating a Transportation problem • Northwest Corner Method
09/05/17 (Week 10)	Aggregate Planning and Production Scheduling	• Sales and Operations Planning • Aggregate Planning Methods • Master production schedule • Level Production
16/05/17 (Week 11)	Materials Requirements Planning	• Material requirements planning • Enterprise resource planning • MRP explosion • Order quantities analysis • Lean production
23/05/17 (Week 12)	Project Presentation	• Project Presentation
30/05/17 (Week 13)	Course Revision	

5. Assessment

Assessment overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Online Quiz x 6	1 hour	30% in total (5% each)	1, 2 and 3	Lecture content (Progressive)	5pm, Friday, Week 2 (10/03), 4 (24/03), 6 (07/04), 8 (28/04), 10 (12/05), 12 (26/05) via Moodle	Immediately after the quiz is closed on Moodle	Immediately after the quiz is closed on Moodle
Group Project Progress Review x 2	5 pages, single sided, min. font size 11	10%	1, 2, 3 and 4	Completeness, originality, level of details, project management and report writing skills	5pm, Friday, Week 4 (24/03) and 9 (05/05) via Moodle	1 week after due date	2 weeks after submission
Group Project	20 pages, single sided, min. font size 11	30%	1, 2, 3 and 4	Completeness, originality, level of details, project management, oral presentation and report writing skills	5pm, Friday, Week 13 (02/06) via Moodle	1 week after due date	2 weeks after submission
Final exam	2 hours	30%	1, 2 and 3	All course content from weeks 1-12 inclusive.	Exam period, date TBC	N/A	Upon release of final results

Assignments

All assignments must be submitted via online through Moodle. No hardcopies will be accepted.

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

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 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.

Where there is no special consideration granted, the 'deadline for absolute fail' in the table above indicates the time after which a submitted assignment will not be marked, and will achieve a score of zero for the purpose of determining overall grade in the course.

Marking

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.

Online Quizzes

Six quizzes (Week 2, 4, 6, 8, 10 and 12) will be conducted online via Moodle. The format of the quiz is similar to those that are done on paper, which consists of multiple choice questions, calculations and short answer questions. The link to the quiz will be available on Monday of the quiz week; the link will remain open until 5pm, Friday of the same week. Each student gets ONE attempt to complete the quiz within a set time limit. The feedback of the quiz will be provided after the quiz is closed. Note that the quiz questions are randomly drawn from a question bank with similar theme and difficulty, numerical questions may appear with random input numbers, so students will not expect to get the exact same question. Students are expected to complete the quiz individually.

Examinations

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 the Exams section on the intranet.

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 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 the School intranet, and the information on UNSW's Special Consideration page.

6. Expected resources for students

Reference books (available via UNSW library)

1. Operations Management – Sustainability and Supply Chain Management, J. Heizer and B. Render, 2014, Pearson Education.

E-books (available via UNSW library)

2. Manufacturing Process Selection Handbook: From Design to Manufacture, Swift K.G., Booker J.D., 2013, Burlington, Elsevier Science.
3. Production and Operations Management, S. Anil Kumar and N. Suresh, 2007, New Age International Publishers.

You may access the UNSW library website via: https://www.library.unsw.edu.au/

7. 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 providing more regular feedbacks to students regarding the major group project. Two mandatory progress reviews will take place in Week 5 and 9 for staffs to provide guidance and feedback to groups. In addition, paper quizzes will be replaced by online quizzes so students can obtain feedback and results immediately after the quiz is closed on Moodle.

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: 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

Further information on School policy and procedures in the event of plagiarism is available on the intranet.

9. Administrative matters

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

- Attendance, Participation and Class Etiquette
- UNSW Email Address
- Computing Facilities
- Assessment Matters (including guidelines for assignments, exams and special consideration)
- Academic Honesty and Plagiarism
- Student Equity and Disabilities Unit
- Health and Safety
- Student Support Services

Ron Chan & Erik van Voorthuysen
Feb 2017

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