

# MANF4100

Design and Analysis of Product-Process Systems

Term 1, 2022



## Course Overview

### Staff Contact Details

#### Convenors

| Name     | Email  | Availability   | Location                  | Phone     |
|----------|--|--|---------------------------|-----------|
| Ron Chan | <a href="mailto:r.chan@unsw.edu.au">r.chan@unsw.edu.au</a> | Send Ron a text using Microsoft Team to book a private consultation session outside class time | ME507, Ainsworth Building | 9385 1535 |

#### Lecturers

| Name                 | Email  | Availability  | Location   | Phone     |
|----------------------|--|---|--|-----------|
| Erik van Voorthuysen | <a href="mailto:erikv@unsw.edu.au">erikv@unsw.edu.au</a> | Send Erik a text using Microsoft Team to book a private consultation session outside class time | <a href="mailto:erikv@unsw.edu.au">erikv@unsw.edu.au</a> | 9385 4147 |

### School Contact Information

#### Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

#### Hours

9:00–5:00pm, Monday–Friday\*

\*Closed on public holidays, School scheduled events and University Shutdown

#### Web

[School of Mechanical and Manufacturing Engineering](#)

[Engineering Student Support Services](#)

[Engineering Industrial Training](#)

[UNSW Study Abroad and Exchange](#) (for inbound students)

[UNSW Future Students](#)

## Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

(+61 2) 9385 4097 – School Office\*\*

\*\*Please note that the School Office will not know when/if your course convenor is on campus or available

## Email

[Engineering Student Support Services](#) – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

[Engineering Industrial Training](#) – Industrial training questions

[UNSW Study Abroad](#) – study abroad student enquiries (for inbound students)

[UNSW Exchange](#) – student exchange enquiries (for inbound students)

[UNSW Future Students](#) – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

[School Office](#) – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries. The School will only be able to refer students on to the relevant team if contacted

## Important Links

- [Student Wellbeing](#)
- [Urgent Mental Health & Support](#)
- [Equitable Learning Services](#)
- [Faculty Transitional Arrangements for COVID-19](#)
- [Moodle](#)
- [Lab Access](#)
- [Computing Facilities](#)
- [Student Resources](#)
- [Course Outlines](#)
- [Makerspace](#)

- [UNSW Timetable](#)
- [UNSW Handbook](#)

## Course Details

### Units of Credit 6

### Summary of the Course

This course integrates the theory and knowledge the theory and practice of designing and analysing manufacturing systems. 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 regional workforce skills and hourly pay 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.

### Course Aims

This course will focus on the tools, analyses and frameworks for selecting and designing production systems, including the fundamentals of flexible manufacturing and Group Technology, as well as the technical and organizational aspects of flexible manufacturing cells and systems.

Most production strategies and systems are computer enabled. Here we refer to a wide range of applications, including but not limited to the design function (both product and process), manufacturing management, product planning, quality control and machine/process control. The successful integration of a majority of these applications may be termed Computer Integrated Manufacturing or CIM. The course also covers the principles of computer aided manufacture, including process planning, CAD/CAM and computer integrated manufacturing.

### Course Learning Outcomes

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 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  | PE2.4, PE3.2, PE3.3     |

| Learning Outcome                                     | EA Stage 1 Competencies |
|--|-------------------------|
| improvement strategies including lean manufacturing. |                         |

## Teaching Strategies

The course material will be presented in the form of lectures and associated book chapters and readings. Understanding will be supplemented by case studies and examples discussed in class. Deeper understanding will be achieved by means of students selecting their own application for designing a product-process system for the manufacture of a product they themselves select or have worked on as part of their mechanical component. The quizzes and final exam will test the understanding of in-depth theory.

## Additional Course Information

This is a 6 unit-of-credit (UoC) course and involves 3 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 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.

## Assessment

| Assessment task            | Weight | Due Date                                    | Course Learning Outcomes Assessed |
|----------------------------|--------|---|-----------------------------------|
| 1. Online Quiz x 3         | 20%    | Thursday Week 3, 7 and 9 at 6PM Sydney Time | 1, 2, 3                           |
| 2. Group project x 2 parts | 40%    | Week 7 and 10                               | 1, 2, 3, 4                        |
| 3. Final exam              | 40%    | Exam Period                                 | 1, 2, 3                           |

### Assessment 1: Online Quiz x 3

**Assessment length:** 75 minutes

**Due date:** Thursday Week 3, 7 and 9 at 6PM Sydney Time

**Deadline for absolute fail:** Not Applicable

**Marks returned:** One week after completing the assessment unless supplementary

Students have to conduct 3 online Moodle quizzes during exam time according to the UNSW Timetable. Each quiz is equally weighted of their final assessment mark.

#### Assessment criteria

- Correct value entered (in filling-the-box questions)
- Correct choice of answer (in multiple choice questions)

Students are expected to submit their working out at the end each quiz. The working out can be in the form of handwritten notes, Excel files, Minitab files or equivalent that demonstrate the student's own work. A separate link will be provided for the submission of the working out.

### Assessment 2: Group project x 2 parts

**Start date:** Week 4

**Assessment length:** Part 1 - 5 pages, Part 2 - 20 pages

**Due date:** Week 7 and 10

**Deadline for absolute fail:** 1 week after the assessment is due

**Marks returned:** Part 1 - On-the-spot feedback Part 2 - Upon release of course result

Students will work in a team (min. 1, max. 3 members per team) to solve a real-life industry-based problem. The assignment will be conducted in 2 parts:

Part 1:

- Construct a production model in the form of a 'Profit Tree'.
- Formulate this problem as a Linear Program. a. Establish the objective function b. List all decision variables c. List and quantify all relevant constraints.
- Obtain the optimal solution using Linear Programming methods.

Part 1 involves submitting a word document and Excel file - No formal report is required.

Part 2:

- Update/correct your base case using the feedback provided in Part 1 of the assignment
- Verify and validate your model.
- List and describe each of the scenarios that you will test using your model.
- Determine the shadow price for each of the constraints.
- Provide professional recommendation for the company.

Part 2 involves writing the assignment up as a professional document with the appropriate headings and chapters. (No VIVA is required for Part 2)

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

### **Additional details**

Part 1 (Word and Excel) 10%

- Profit tree (/5)
- Base case setup – including the objective functions, constraints and optimal solution (/2)
- Base case solution accuracy (3)

Part 2 (Report) 30%

- Executive Summary – provide the problem, methodology and recommendations in plain English (/3)
- Improved profit tree (/2)
- Improved base case – including the objective functions, constraints and optimal solution (/2)
- Quality of the scenarios (/3)
- Accuracy of the scenarios (/5)
- Shadow price – assessment of the shadow price in plain English (/5)
- Recommendation – provide a concise, clear and professional recommendations using plain English for all key findings (/5)
- Documentation – readability of the document (/5)

### **Assessment 3: Final exam**

**Start date:** Exam Period

**Submission notes:** Moodle Exam

**Due date:** Exam Period

**Marks returned:** Upon release of course result

The final exam will be centrally managed and will cover all contents in the course.

This is not a Turnitin assignment

### **Assessment criteria**

- Correct value entered (in filling-the-box questions)
- Correct choice of answer (in multiple choice questions)



Students are expected to submit their working out at the end of the exam. The working out can be in the form of handwritten notes, Excel files, Minitab files or equivalent that demonstrate the student's own work. A separate link will be provided for the submission of the working out.

## Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

## Course Schedule

[View class timetable](#)

### Timetable

| Date                              | Type       | Content   |
|-----------------------------------|------------|---|
| Week 1: 14 February - 18 February | Lecture    | <b>Introduction to Product-Process Systems, Key Factors of Success</b> <ul style="list-style-type: none"> <li>• Global Manufacturing Issues</li> <li>• Comparison of Manufacturing Sectors</li> <li>• Competitive Strategy</li> <li>• Push – Pull Systems</li> <li>• Volume – Variety</li> <li>• Productivity – Flexibility</li> <li>• Global – Local Manufacturing</li> <li>• Product-Process Matrix</li> <li>• Production Process Strategies</li> </ul> |
| Week 2: 21 February - 25 February | Lecture    | <b>Line Balancing</b> <ul style="list-style-type: none"> <li>• Flexibility</li> <li>• Reliability</li> <li>• Agility</li> <li>• Scalability</li> <li>• Economic Factors</li> <li>• Sustainable Manufacturing</li> <li>• Line Balancing</li> </ul>   |
| Week 3: 28 February - 4 March     | Lecture    | <b>Resource Allocation – Linear Programming 1</b> <ul style="list-style-type: none"> <li>• Formulating an LP problem</li> <li>• Simplex Method</li> <li>• Geometry of the Simplex Method</li> <li>• Using Microsoft Excel Solver</li> </ul>   |
|                                   | Assessment | Online Quiz 1   |
| Week 4: 7 March - 11 March        | Lecture    | <b>Resource Allocation – Linear Programming 2</b> <ul style="list-style-type: none"> <li>• Formulating a Transportation problem</li> <li>• Northwest Corner Method</li> </ul>   |

|                              |            |  |
|------------------------------|------------|--|
|                              |            | <ul style="list-style-type: none"> <li>• Sensitivity analysis</li> </ul>   |
| Week 5: 14 March - 18 March  | Lecture    | <b>Resource Allocation – Linear Programming 3</b> <ul style="list-style-type: none"> <li>• Transportation Model</li> <li>• North-West Corner Method</li> <li>• Simplified Simplex Method for Transportation Model</li> </ul>   |
| Week 6: 21 March - 25 March  | Lecture    | <b>Flexibility Week</b> <ul style="list-style-type: none"> <li>• Revision</li> <li>• Assignment support</li> </ul>   |
| Week 7: 28 March - 1 April   | Lecture    | <b>Forecasting Techniques</b> <ul style="list-style-type: none"> <li>• Forecasting Time Horizons</li> <li>• Types of Forecasts</li> <li>• The Forecasting Process</li> <li>• Time Series Forecasting</li> <li>• Moving Average</li> <li>• Exponential Smoothing</li> <li>• Measuring Forecasting Error</li> <li>• Trend Adjustment</li> <li>• Seasonal Variation</li> <li>• Regression Analysis</li> </ul> |
|                              | Assessment | Assignment Part 1  |
|                              | Assessment | Online Quiz 2  |
| Week 8: 4 April - 8 April    | Lecture    | <b>Aggregate Planning and Production Scheduling</b> <ul style="list-style-type: none"> <li>• Sales and Operations Planning</li> <li>• Aggregate Planning Methods</li> <li>• Master production schedule</li> <li>• Level Production</li> </ul>  |
| Week 9: 11 April - 15 April  | Lecture    | <b>Materials Requirements Planning, Lean Manufacturing</b> <ul style="list-style-type: none"> <li>• Material requirements planning</li> <li>• Enterprise resource planning</li> <li>• MRP explosion</li> <li>• Order quantities analysis</li> <li>• Lean production</li> </ul>   |
| Week 10: 18 April - 22 April | Lecture    | <b>Wrap-Up and Revision</b>  |

|  |            |                          |
|--|------------|--------------------------|
|  |            | • Final exam preparation |
|  | Assessment | Online Quiz 3            |

## **Resources**

### **Prescribed Resources**

Operations Management – Sustainability and Supply Chain Management, J. Heizer and B. Render, 2016, Pearson Education. 9781292148656

You can find a free e-copy of the textbook from the UNSW library.

### **Recommended Resources**

Operations Management – Sustainability and Supply Chain Management, J. Heizer and B. Render, 2016, Pearson Education. 9781292148656

You can find a free e-copy of the textbook from the UNSW library.

### **Course Evaluation and Development**

In this course, recent improvements resulting from student feedback include provide major assignment feedback prior to the final report submission.

### **Laboratory Workshop Information**

N/A

# Submission of Assessment Tasks

## Assessment submission and marking criteria

Should the course have any non-electronic assessment submission, these should have a standard School cover sheet.

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.

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.

## Late policy

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, for a minimum of zero marks.

The late penalty is applied per calendar day (or part thereof), including weekends and public holidays, that the assessment is overdue.

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

- Your course has an assessment task worth a total of **30 marks (Max Possible Mark)**
- You submit the assessment **2 days after the due date**
- The assessment is marked as usual and achieves a score of **20 marks (Awarded Mark)**
- The late policy is applied using **Late Mark = Awarded Mark - (Days\*Penalty per Day)\*Max Possible Mark**. Your adjusted final score is **8 marks** ( $20 - ((2*0.2)*30)$ ).

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:

1. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
2. Online quizzes where answers are released to students on completion, or
3. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
4. Pass/Fail assessment tasks.

## Examinations

You must be available for all quizzes, tests and examinations. For courses that have final examinations, these 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.

## Special Consideration

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.

UNSW now has a [Fit to Sit / Submit rule](#), which means that if you attempt 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](#).

**Please note** that students will **not** be required to provide **any** documentary evidence to support absences from any classes missed **because of COVID-19 public health measures such as isolation**. UNSW will **not** be insisting on medical certificates from anyone deemed to be a positive case, or when they have recovered. Such certificates are difficult to obtain and put an unnecessary strain on students and medical staff.

Applications for special consideration **will** be required for assessment and participation absences – but no documentary evidence **for COVID-19 illness or isolation** will be required.

## Special Consideration Outcomes

Assessments have default Special Consideration outcomes. The default outcome for the assessment will be advised when you apply for Special Consideration. Below is the list of possible outcomes:

| <b>Outcome</b>           | <b>Explanation</b>   | <b>Example</b>  |
|--------------------------|--|---|
| Time extension           | Student provided more time to submit the assessment  | e.g. 1 more week of time granted to submit a report   |
| Supplementary assessment | Student provided an alternate assessment at a later date/time  | e.g. a supplementary exam is scheduled during the supplementary exam period of the term   |
| Substitute item          | The mark for the missed assessment is substituted with the mark of another assessment  | e.g. mark for Quiz 1 applied also applied as mark for Quiz 2, meaning if a student achieved a mark of 20/30 for Quiz 1 and was granted Special Consideration for Quiz 2, a mark of 20/30 would be applied for Quiz 2, etc   |
| Exemption                | All course marks are recalculated excluding this assessment and its weighting  | e.g. The course has an assessment structure of:<br>- Assignments 30%,<br>- Lab report 30%,<br>- Final Exam 40%.<br>If the Lab report is missed and student is granted Special Consideration, then the assessment structure may be reweighted as follows:<br>- Assignments 50%<br>- Final Exam 50%<br>as though the Lab report did not exist |
| Non-standard             | Course Coordinator is contacted for the outcome when special consideration is granted as the outcome differs on a case-by-case basis | e.g. typical for group assessments where time extension supplementary assessment could be granted to the group member, time extension could be granted to the whole group, etc. Clarify with your Course Convenor for   |



## 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](http://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](http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf)

## Academic Information

### Credit points

Course credit is calculated in Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study, other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

### On-campus class attendance

**\*\*T1-2022 UPDATE\*\***

Public distancing conditions must be followed for all face-to-face classes. To ensure this, only students enrolled in those classes will be allowed in the room. No over-enrolment is allowed in face-to-face classes. Students enrolled in online classes can swap their enrolment from online to on-campus classes by Sunday, Week 1. Please refer to your course's Microsoft Teams and Moodle sites for more information about class attendance for in-person and online class sections/activities.

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by [NSW health](#) or government authorities. Current alerts and a list of hotspots can be found [here](#). **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate.** We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed. Further information is available on any course Moodle or Teams site.

In certain classroom and laboratory situations where physical distancing cannot be maintained or there is a high risk that it cannot be maintained, face masks will be considered **mandatory PPE** for students and staff.

For more information, please refer to the FAQs: <https://www.covid-19.unsw.edu.au/safe-return-campus-faqs>

### Guidelines

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

- [Attendance](#)
- [UNSW Email Address](#)
- [Special Consideration](#)
- [Exams](#)
- [Approved Calculators](#)

- [Academic Honesty and Plagiarism](#)

## **Image Credit**

Photo by Stephen Blake March 2017, Willis Annexe (J18) Thermofluids lab

## **CRICOS**

CRICOS Provider Code: 00098G

## **Acknowledgement of Country**

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

## Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

| Program Intended Learning Outcomes  |   |
|---|---|
| Knowledge and skill base  |   |
| PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline | ✓ |
| PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline          | ✓ |
| PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline  |   |
| PE1.4 Discernment of knowledge development and research directions within the engineering discipline  |   |
| PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline  | ✓ |
| PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline                             | ✓ |
| Engineering application ability   |   |
| PE2.1 Application of established engineering methods to complex engineering 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  | ✓ |
| Professional and personal attributes  |   |
| PE3.1 Ethical conduct and professional accountability   |   |
| PE3.2 Effective oral and written communication in 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   |   |