FACULTY OF ENGINEERING
SCHOOL OF MECHANICAL AND MANUFACTURING ENGINEERING

MANF3510

COMPUTER APPLICATIONS IN MANUFACTURING

SESSION 2, 2012
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1. STAFF CONTACT DETAILS

Dr. Huaizhong Li, (Course Convenor, Lecturer)
Room: MME 116; Ph: 9385 5587
Email: hz.li@unsw.edu.au

Mr. Martyn Sherriff
Room: ME M4; Ph: 9385 4113
Email: m.sherriff@unsw.edu.au

Mr. Seetha Mahadevan
Room: ME M2; Ph: 9385 4109
Email: smahadevan@unsw.edu.au

Matters relating to course administration should be directed to Dr H. Li.

Consultation Times - Dr. Huaizhong Li:
Consultation concerning this course is available on Thursday 16:00–17:00 in the lecturer's office whenever the lecturer is not otherwise engaged.

2. COURSE DETAILS

Units of credit

This is a 6 unit-of-credit (UoC) course. 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.”

For a standard 24 UoC in the session, this means 600 hours, spread over an effective 15 weeks of the session (thirteen weeks plus stuvac plus one effective exam week), or 40 hours per week, for an average student aiming for a credit grade
Various factors, such as your own ability, your target grade, etc., will influence the time needed in your case. Some students spend much more than 40 h/w, but you should aim for not less than 40 h/w on coursework for 24 UoC.

This means that you should aim to spend not less than about 10 h/w on this course, i.e. an additional 5 h/w of your own time. This should be spent in making sure that you understand the lecture material, completing the set assignments, further reading about the course material, and revising and learning for the examination.

Relation to other course offerings and the overall program(s) in the discipline
This is a core course in the Manufacturing Technology and Management program.

Parallel teaching
The course is organized in two parts, **Part A: Process Technology**, which deals with technical and programming aspects of automation and control, and **Part B: Flexible Manufacturing**, which deals with strategic and organizational aspects and higher level technologies aimed at Computer Integrated Manufacturing. This course involves four (4) contact hours per week of face-to-face lectures and tutorials. In addition, the course will also incorporate non-contact time in the form of assignments and laboratory work. MANF3510 carries 6 UOC.

These parts are equally weighted toward final mark (50% each).

Each class will consist of a 1-2 hrs lecture followed by a tutorial work or assignments related to the material covered in the lecture. Details for the formal part of the course are as follows:

4hrs/week, Session 2

<table>
<thead>
<tr>
<th>Part A: Process Technology</th>
<th>Part B: Flexible Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monday 9:00 – 11:00</strong></td>
<td><strong>Wednesday 16:00 – 18:00</strong></td>
</tr>
<tr>
<td>Mechanical Eng 202 (K-J17-202)</td>
<td>Mechanical Eng 202 (K-J17-202)</td>
</tr>
<tr>
<td><strong>Monday 11:00 – 12:00</strong></td>
<td></td>
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<tr>
<td>ME 206</td>
<td></td>
</tr>
</tbody>
</table>

**Course aims**

Key factors for success in modern manufacturing include quality, productivity, efficiency, flexibility, customer satisfaction and control over cost and logistics. Depending on the characteristics of the product and its market, an appropriate manufacturing system and key enabling technologies (such as automation) need to be selected. Part A of this course deals with common manufacturing processes and technologies, the control of these processes as well as materials handling and robotics. Part B of this course deals with higher level enabling technologies, cellular manufacturing, flexible manufacturing, CAD/CAM, CAPP, CIM as well as strategic issues such as cost justification and competitive advantage. This course includes a substantial amount of laboratory work.

**Part A: Process Technology**

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 tutorial work, the procedure of CNC programming, industrial robots and their programming and programmable logic controllers (PLC).

Topics include:

- Function and control of CNC machine tools
- Sensors and actuators in automated systems
- Manufacturing system performance and productivity
Part B: Flexible Manufacturing

Part B of the course builds on the knowledge of the basic elements of computerized manufacture, covered in Part A. Part B incorporates and integrates this fundamental knowledge into the design of computerised production strategies and systems. Part B will focus on the tools, analyses and frameworks for selecting and designing computerised and automated production systems, including the fundamentals of 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 final part covers the principles of Computer Aided Manufacture, including process planning, CAD/CAM and Computer Integrated Manufacture.

Student learning outcomes

Technical capabilities:

If you participate in and pass this course module, you should be able to:

- Have a comprehensive overview of the field of computerized manufacturing and automation, including its terminology as well as major classes of technology, hardware and applications.
- Incorporate and integrate the fundamental knowledge of computerised manufacture into the design of computerised production strategies and systems.
- Understand and use the appropriate techniques and analyses for the selection, design and evaluation of computerised and automated production systems.
- Explain the concept of Group Technology (GT) and Flexible Manufacturing Systems.
- Know the appropriate approaches in planning and evaluating of modern manufacturing systems, such as an FMS.
- Know the various technologies and techniques available for setting up an integrated manufacturing system.

Graduate attributes

UNSW’s graduate attributes are shown at https://my.unsw.edu.au/student/atoz/GraduateAttributes.html and are:
1. the skills involved in scholarly enquiry;
2. ✓ an in-depth engagement with the relevant disciplinary knowledge in its interdisciplinary context;
3. ✓ the capacity for analytical and critical thinking and for creative problem solving;
4. the ability to engage in independent and reflective learning;
5. ✓ information literacy — the skills to locate, evaluate and use relevant information;
6. the capacity for enterprise, initiative and creativity;
7. an appreciation of, and respect for, diversity;
8. a capacity to contribute to, and work within, the international community;
9. ✓ the skills required for collaborative and multidisciplinary work;
10. an appreciation of, and a responsiveness to, change;
11. a respect for ethical practice and social responsibility; and
12. ✓ the skills of effective communication.

✓ = Developed in this course

A statement of broad graduate attributes has meaning when expressed in the context of the discipline. The graduate attributes contextualised for engineering are shown at http://teaching.unsw.edu.au/sites/default/files/upload-files/GradAttrEng.pdf

In this course, you will be encouraged to develop Graduate Attributes 2, 3, 5 and 9 by undertaking the selected activities and knowledge content. These attributes will be assessed within the prescribed assessment tasks.

By the completion of this course, you should have become aware of your current abilities, and enhanced your following generic and professional capabilities:

(1) Written and oral communication skills
(2) Managing time and prioritising activities
(3) Critical thinking, problem solving, team work and life-long learning skills
(4) Skills in retrieving, evaluating, presenting and using relevant information
(5) An attitude towards and ability to apply the latest methods and technology

Graduate discipline-specific attributes

On completion of the course it is expected that the student will be able to:

- Understand and describe the essential building blocks of factory automation, including machine tools, materials handling, control, actuation and sensing devices.
- Distinguish between different levels of automation and the evolution of machine tools and robotics.
- Understand and analyse control strategies for automation technology such as CNC machine tools.
- Analyse the costs and benefits associated with introducing factory automation.
Understand and describe the performance of automated devices, such as machine tools, in terms of cycle time, duty cycle, productivity, accuracy and repeatability.

List and describe the major classes of industrial robots and their applications and performance characteristics.

Design and write practical low-level programs for machine tools (G-code) and programmable logic controllers (ladder programming).

Understand essential kinematic and dynamic considerations in the design and selection of robots.

Understand the functions, internal operation and applications of programmable logic controllers (PLC).

Use advanced and high-level computer aided design technology to design a product part and to automatically generate CNC manufacturing code.

Gain valuable experience by manufacturing one design on the School’s Flexible Manufacturing Lab.

Understand the manufacturing strategies of group technology, cellular manufacturing, flexible and computer-integrated manufacturing.

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

In addition to the course contact hours and assignment work, it is expected that the student will put in, on average, an additional 4 hours per week of his/her own time (including stuvac and exams). This time should be spent in revising the lecture material and further reading, completing tutorial questions, completing the assignment and revising and learning for the examinations.

3. RATIONALE FOR INCLUSION OF CONTENT AND TEACHING APPROACH

The lecturers will provide the necessary resources, guidance and assistance for the achievement of the course objectives (or your goals), and also attempt to provide you with a friendly and enjoyable environment to enhance your learning experience, where you will feel comfortable in expressing your thoughts and appreciate the points of view of your fellow students. You will be invited to be engaged in the learning and teaching process and to take an active role in the course to facilitate your understanding of the course content. You will also be provided an opportunity to undertake extensive reading and report writing as part of assignments to develop your generic attributes.

4. TEACHING STRATEGIES

The subject will be presented in the form of lectures, tutorials and assignments, including laboratory work.

- The lectures will consider in some details the topics covered in the course, to develop the necessary skills in the understanding of the concepts and principles.
- The tutorials are to address some exercises/examples and problems as well as to assist you with questions on the materials taught in the lectures.
• There are assignments that will enable you to develop your skills to learn and apply knowledge to solve practical problems and to development your generic attributes.

The lecture materials are available from the Blackboard, and the reference books can be found in the University Library. It is required that you read the lecture materials before coming to each lecture; where possible attempting the tutorial questions before the class. In order for you to (thoroughly) understand the course content, you are expected to read a wide range of materials related to the course, such as those listed in the Resources section.

You will have access to the lecturers either in person or via email for consultations on matters associated with this course.

Today’s industry expects university graduates to possess a variety of skills and capabilities, such as excellent communication skills (both written and oral), good problem-solving and critical-thinking skills, a willingness to understand the opinions of others, the ability to work well within a team, and the ability to conduct themselves in a professional manner. As such, this course is also designed to help you to develop some of the skills and capabilities, as mentioned earlier, and to make you more prepared to meet the needs and expectations of your future employers.

Suggested approaches to learning in the course

• Be present and attentive at all lectures, tutorials and practical work.
• 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 tutorials, and asking questions when anything is not understood.
• Conscientiously working through the set assignments.
• Learning of the lecture material in preparation for examinations.

5. ASSESSMENT

The students are assessed by ways of assignments, quizzes, tutorial submissions and examinations. Examinations and quizzes involve both calculations and descriptive materials.

Part A: Process Technology

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-session test</td>
<td>20%</td>
</tr>
<tr>
<td>Assignment 1</td>
<td>10%</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>15%</td>
</tr>
<tr>
<td>Assignment 3</td>
<td>15%</td>
</tr>
<tr>
<td>End of session test</td>
<td>40%</td>
</tr>
</tbody>
</table>

Assessment Components
(1) Type: Mid-session test  
Description: A test of about 1 hour will be held in the middle of the session. The test will cover materials from lectures 1 to 6.  
Due date: Week 7.  
Weight: 20%  
(2) Type: Assignment on G-code programming  
Description: You will be required to write a program in G-code for the realization and production of a standard component, the design of which will be given in class.  
Due date: Week 8.  
Weight: 10%  
(3) Type: Assignment on CATIA cad/cam programming  
Description: You will be required to create a design and machining program written in CATIA for the realization and production of a standard component, the design of which will be given in class.  
Due date: Week 8.  
Weight: 15%  
(4) Type: Assignment on PLC programming  
Description: You will be required to write a PLC program in ladder format with the purpose of automating an industrial process.  
Weight: 15%  
(5) Type: Final examination  
Description: A "closed book" examination will be held at the end of the session, covering all course materials.  
Due date: End of session.  
Weight: 40%  

Part B: Flexible Manufacturing  
<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment</td>
<td>30%</td>
</tr>
<tr>
<td>Mid-session test</td>
<td>20%</td>
</tr>
<tr>
<td>Class Assessment</td>
<td>10%</td>
</tr>
<tr>
<td>End of session test</td>
<td>40%</td>
</tr>
</tbody>
</table>

Assessment Components  
(1) Type: Investigative Report (Assignment) on CIM  
Description: You will be required to give a presentation in the class and submit an written report for the Assignment. This assessment is related to Technical Capabilities (1) to (3) and Generic Attributes (1) to (5).  
Due date: Written assignment and presentation slides due Week 9.  
Weight: 30%  
(2) Type: Mid-session test  
Description: A test of about 30-40 minutes will be held in the middle of the session. The test will cover materials from lectures 1 to 6 and relate to Technical Capabilities (1) to (3) and Generic Attributes (1), (3) and (4).  
Due date: Middle of session.  
Weight: 20%  
(3) Type: Mini-assessments and attendance to class discussions
Description: Mini-assessment to tutorials and class discussions, including active participation to student seminar presentations. Related to all stated Technical Capabilities and Generic Attributes.
Due date: Throughout the session.
Weight: 10%

(4) Type: Final examination
Description: A "closed book" examination will be held at the end of the session, covering all course materials and relating to Technical Objectives (1) to (3) and Generic capabilities (3) and (5). Note that the final examination may include materials from the student presentations.
Due date: End of session.

A standard specification is available from the School office to aid presentation of your assignments (in all courses). All submissions should have a standard School cover sheet. All submissions are expected to be neat and clearly set out.

Late Submission
Late submission of assignment will incur a penalty on the mark at one mark per calendar day, unless approved by the course convener based on acceptable reasons. Note that busy study schedule is not an acceptable reason. An application for late submission must be made before the submission due date.

Pass Parameters
All assignments are compulsory; you will fail this course if you do not satisfactorily complete the assignments. You must also achieve a minimum of 40% in the final examination in order to pass this course. Otherwise, your final mark will be min{45%, your achieved mark}.

No deferred or supplementary test will be held for the mid-session tests. If you are unable to attend the test for an acceptable reason, you must make a written application prior to, or for medical reason within 5 days following the test date. In such a case, your final mark for the relevant part will be adjusted (i.e. divided by 8 and multiplied by 10).

The assessments are based to allow students to obtain an understanding of the material presented. The mid-session tests will gauge the understanding of early fundamentals of the course, while the assignments will allow the students to apply these concepts in a practical sense. The end of session examination to determine the level of understanding the student has achieved in the total course. The end of session examination will cover all material taught in both parts of the course, from week 1-13 inclusive.

6. ACADEMIC HONESTY AND PLAGIARISM

What is Plagiarism?
Plagiarism is the presentation of the thoughts or work of another as one’s own.* Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document
(whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person’s assignment without appropriate acknowledgement;

• paraphrasing another person’s work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
• piecing together sections of the work of others into a new whole;
• presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
• claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does not amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

• correct referencing practices;
• paraphrasing, summarising, essay writing, and time management;
• appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students 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 items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle
† Adapted with kind permission from the University of Melbourne.

Further information on School policy and procedures in the event of plagiarism is presented in a School handout, Administrative Matters for All Courses, available from the School website.
### 7. COURSE SCHEDULE

**Part A: Process Technology**  
(Monday  9:00 – 11:00, Mechanical Eng 202)

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
<th>Instructor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16/7</td>
<td>Control of Machine Tools &amp; NC tools</td>
<td>Li</td>
</tr>
<tr>
<td>2</td>
<td>23/7</td>
<td>NC Part Programming</td>
<td>Li</td>
</tr>
<tr>
<td>3</td>
<td>30/7</td>
<td>CNC Programming, CATIA Lab</td>
<td>MS, SM, Li</td>
</tr>
<tr>
<td>4</td>
<td>6/8</td>
<td>Turning and Machining Centers</td>
<td>MS, SM, Li</td>
</tr>
<tr>
<td>5</td>
<td>13/8</td>
<td>Industrial Robotics 1</td>
<td>Li</td>
</tr>
<tr>
<td>6</td>
<td>20/8</td>
<td>Industrial Robotics 2</td>
<td>Li</td>
</tr>
<tr>
<td>7</td>
<td>27/8</td>
<td>Mid-session test part A; Industrial Robotics 3</td>
<td>Li</td>
</tr>
<tr>
<td></td>
<td>3-9/9</td>
<td>Mid-session Break</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10/9</td>
<td>Industrial Robotics 4</td>
<td>Li</td>
</tr>
<tr>
<td>9</td>
<td>17/9</td>
<td>Programmable Logic Controllers 1</td>
<td>Li</td>
</tr>
<tr>
<td>10</td>
<td>24/9</td>
<td>Programmable Logic Controllers 2</td>
<td>Li</td>
</tr>
<tr>
<td>11</td>
<td>1/10</td>
<td>(PH, no class)</td>
<td>Li</td>
</tr>
<tr>
<td>12</td>
<td>8/10</td>
<td>Pneumatics</td>
<td>Li</td>
</tr>
<tr>
<td>13</td>
<td>15/10</td>
<td>Revision</td>
<td>Li</td>
</tr>
</tbody>
</table>

Li = Dr Huaizhong Li, MS = Martyn Sherriff, SM = Mr Seetha Mahadevan

### Part B: Flexible Manufacturing

(Wednesday  16:00 – 18:00, Mechanical Eng 202)

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18/07</td>
<td>Introduction to Automation &amp; CIM</td>
</tr>
<tr>
<td>2</td>
<td>25/07</td>
<td>Computer controls - CNC/DNC/AC</td>
</tr>
<tr>
<td>3</td>
<td>01/08</td>
<td>Group Technology (GT)</td>
</tr>
<tr>
<td>4</td>
<td>8/08</td>
<td>Group Technology (GT)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flexible Manufacturing Cell (FMC)</td>
</tr>
<tr>
<td>5</td>
<td>15/08</td>
<td>Flexible Manufacturing Systems (FMS) -1</td>
</tr>
<tr>
<td>6</td>
<td>22/08</td>
<td>Flexible Manufacturing Systems (FMS) -2</td>
</tr>
<tr>
<td>7</td>
<td>29/08</td>
<td>Automatic Inspection Systems</td>
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<tr>
<td></td>
<td></td>
<td>Mid-session break</td>
</tr>
<tr>
<td>8</td>
<td>12/09</td>
<td>Mid-session test (cover weeks 1 to 6)</td>
</tr>
<tr>
<td>9</td>
<td>19/09</td>
<td>CAPP</td>
</tr>
<tr>
<td>10</td>
<td>26/09</td>
<td>Investigative project (student presentations)</td>
</tr>
<tr>
<td>11</td>
<td>03/10</td>
<td>Investigative project (student presentations)</td>
</tr>
<tr>
<td>12</td>
<td>10/10</td>
<td>Computer Integrated Manufacturing (CIM)</td>
</tr>
<tr>
<td>13</td>
<td>17/10</td>
<td>Summary/revision</td>
</tr>
</tbody>
</table>
8. RESOURCES FOR STUDENTS

Lecture notes will be available on Blackboard.

Textbooks:


REFERENCE BOOKS:


Students seeking resources can also obtain assistance from the UNSW Library. One starting point for assistance is: info.library.unsw.edu.au/web/services/services.html

9. COURSE EVALUATION AND DEVELOPMENT

Periodically student evaluative feedback on the course is gathered, using among other means, UNSW’s Course and Teaching Evaluation and Improvement (CATEI) process. Student 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 reduction in the number of assignments and more industrial examples and case studies.

10. ADMINISTRATIVE MATTERS

Information about each of the following matters is presented in a School handout, Administrative Matters for All Courses, available from the School website

It is essential that you obtain a copy, read it carefully and become familiar with the information, because it applies to this course and to each of the other courses in which you are enrolled.

Expectations of students (including attendance at lectures and tutorials/laboratory classes/seminars; and computer use, for example, in the use of email and online discussion forums)

Procedures for submission of assignments and the School’s policy concerning late submission

Information on relevant Occupational Health and Safety policies and expectations:

www.ohs.unsw.edu.au

Examination procedures and advice concerning illness or misadventure

Equity and disability

Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convenor prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Student Equity and Disability Unit (SEADU) by phone on 9385 4734, email seadu@unsw.edu.au or via the website

www.studentequity.unsw.edu.au/content/default.cfm?ss=0

The office is located on the Ground Floor of the John Goodsell building (F20).

Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

Dr Huaizhong Li
July 2012