University of Macau
Department of Electromechanical Engineering
MECH412 - Computer Aided Manufacturing
Syllabus
2nd Semester 2011/2012
Part A – Course Outline

Compulsory course in Electromechanical Engineering

Course description:

Introduction to the fundamental concepts of manufacturing systems, computer-aided process planning, CNC programming, group technology and its applications, facility layout, flexible manufacturing system, rapid prototyping, and product lifecycle management. Advanced CAD/CAM software and machine tools will be intensively used throughout the practice session.

Prerequisite:

MECH403 – Computer-aided Design

Textbook

- T. C. Chang, R. A. Wysk, H. P. Wang. ***Computer Aided Manufacturing****, 3nd Edition*, Prentice-Hall, 2006. ISBN: 0131293346

References:

- K. Lee. *Principles of CAD/CAM/CAE Systems,* Addison Wesley, 1999. ISBN: 0-201-38036-6
- Steve Krar, Arthur Gill. Exploring Advanced Manufacturing Technologies, Industrial Press, 2003. ISBN: 0831131500
- Mikell P. Groover. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 2nd Edition, Wiley, 2001. ISBN: 0471400513

Course objectives:

1. Introduce to students the fundamental knowledge of modern manufacturing systems. [c, k]
2. Introduce to students modeling and analysis of manufacturing planning. [a, e, l]
3. Introduce to students engineering management knowledge in advanced manufacturing. [b, d, f, h, j]

Topics covered:

1. **Introduction of manufacturing systems –** Review of syllabus, Types of manufacturing systems, Current manufacturing technologies.
2. **Engineering Tolerances –** Dimensioning; Fits and Limits; Geometric Tolerances, Tolerance analysis (dimensional tolerance graph analysis and worst-case method).
3. **Process planning –** Manual Process Planning, Variant Approach, Computer Aided Process Planning, Feature based technology.
4. **Numerical Control –** Fundamentals of numerical control; CNC part programming; Computer aided part programming.
5. **Rapid prototyping technology –** Product Realization Processes, Rapid prototyping methods [Laminated Object Manufacturing (LOM), Stereo-Lithography Apparatus (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM)]. STA processing.
6. **Group technology and its applications –** Classification and Coding; Cluster Analysis Method; Its practical applications (a) optimize planning of manufacturing processes; (b) how this is related to the design of manufacturing cells.
7. **Flexible manufacturing system –** Manufacturing cell, manufacturing planning in FMS.
8. **Product Lifecycle Management –** Principle of Concurrent engineering, QFD, Design structure matrix, Product data management, Safety and environmental considerations, Green manufacturing.

Class schedule and credits:

Timetabled work in hours per week			No of teaching weeks	Total hours	Total credits	No / Duration of exam papers
Lecture	Tutorial	Practice				
2	0	2	14	56	3.5	1 / 3 hours

Topic Outline: (Optional)

Week No.	No. of hours	Topics
1	4	**Introduction of manufacturing systems** Review of syllabus, Types of manufacturing systems, Current manufacturing technologies.
2, 3	8	**Engineering Tolerances** Dimensioning; Fits and Limits; Geometric Tolerances, Tolerance analysis (dimensional tolerance graph analysis and Worst-case method).
4, 5	8	**Process planning** Manual Process Planning, Variant Approach, Computer Aided Process Planning, Feature based technology
6, 7, 8	12	**Numerical Control** Fundamentals of numerical control; CNC part programming; Computer aided part programming
9	8	**Rapid prototyping technology** Product Realization Processes, Rapid prototyping methods [Laminated Object Manufacturing (LOM), Stereo-Lithography Apparatus (SLA), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM)]. STA processing.
10, 11, 12	12	**Group technology and its applications** Classification and Coding; Cluster Analysis Method; Its practical applications (a) optimize planning of manufacturing processes; (b) how this is related to the design of manufacturing cells.
13	8	**Flexible manufacturing system** Manufacturing cell, manufacturing planning in FMS
14	4	**Product Lifecycle Management** Principle of Concurrent engineering, QFD, Design structure matrix, Product data management, Safety and environmental considerations, Green manufacturing.

Contribution of course to meet the professional component:

This course prepares students to work professionally in the area of **manufacturing**.

Relationship to EME programme objectives and outcomes:

This course primarily contributes to Electromechanical Engineering Programme outcomes that develop student abilities to:

(a) An ability to apply knowledge of mathematics, science, and engineering;
(c) An ability to design a system, component, or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability;
(e) An ability to identify, formulate, and solve engineering problems;
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice appropriate to the degree discipline;
(l) An ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations.

The course secondarily contributes to Electromechanical Engineering programme outcomes that develop student abilities to:

(b) An ability to design and conduct experiments, as well as to analyze and interpret data;
(d) An ability to function on multidisciplinary teams;

(f) An understanding of professional and ethical responsibility;
(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context, especially the importance of health, safety and environmental considerations to both workers and the general public;
(j) A knowledge of contemporary issues.

Course content:

Maths	Basic Sciences	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies	Total 100%
20	0	35	10	0	35	100

Persons who prepared this description:

Dr. Zhixin Yang

Part B General Course Information and Policies

2nd Semester 2011/2012

Instructor: Dr. Zhixin Yang
Office: N406
Office Hour: By appointment
Phone: (853) 8397-4456
Email: zxyang@umac.mo

Time/Venue:

TBA

Assessment:

Final assessment will be determined on the basis of:

Homework:	15%
In-class Quizzes:	5%
Course Project:	25%
Mid-term:	25%
Final Exam:	30%

Grading System:

The credit is earned by the achievement of a grade from 'A' to 'D'; 'F' carries zero credit.

Grades are awarded according to the following system:

Letter Grades	Grade Points	Percentage
A	4.0 (Excellent)	93-100
A-	3.7 (Very good)	88-92
B+	3.3	83-87
B	3.0 (Good)	78-82
B-	2.7	73-77
C+	2.3	68-72
C	2.0 (Average)	63-67
C-	1.7	58-62
D+	1.3	53-57
D	1.0 (Pass)	50-52
F	0 (Fail)	Below 50

Comment:

The objectives of the lectures are to explain and to supplement the text material. Students are responsible for the assigned material whether or not it is covered in the lecture. Students who wish to succeed in this course should read the assignments prior to the lecture and should work all homework and lab assignments. You are encouraged to look at other sources (other texts, notes and webpage, etc.) to complement the lectures and text.

Homework Policy:

The completion and correction of homework is a powerful learning experience; therefore:

- There will be approximately 5 homework assignments.
- Homework is due one week after assignment unless otherwise noted, no late homework is accepted.
- Possible revision of homework grades may be discussed with the grader within one week from the return of the marked homework
- The homework grade will be based on the average of the assignment grades.

Quizzes/Mid-terms Exams:

One mid-term exam and one in-class quiz will be held during the semester.

Note:

- Recitation session is important part of this course and attendance is strongly recommended.
- Check UMMoodle (webcourse.umac.mo) for announcement, homework and lectures. Report any mistake on your grades within one week after posting.
- No make-up exam is give except for CLEAR medical proof.
- No exam is given if you are 15 minutes late in the midterm exams and 30 minutes late in the final exam. Even if you are late in the exam, you must turn in at the due time.
- Cheating is absolutely prohibited by the university.

Appendix - Rubric for Programme Outcomes

Rubric for (a)	5 (Excellent)	3 (Average)	1 (Poor)
Understand the theoretic background	Students understand theoretic background and the limitations of the respective applications.	Students have some confusion on some background or do not understand theoretic background completely	Students do not understand the background or do not study at all
Use a correct model and formulation correctly	Students choose a model correctly and properly apply correct techniques	Students choose a wrong model sometime, use a wrong formula, or a different technique	Students use a wrong model and wrong formula, or do not know how to model
Compute the problem correctly	Students use correct techniques, analyze the problems, and compute them correctly	Students sometime solve problem mistakenly using wrong techniques	Students do not know how to solve problems or use wrong techniques completely

Rubric for (b)	5 (Excellent)	3 (Average)	1 (Poor)
Conduct experiments	Student successfully completes the experiment, records the data, analyzes the experiment's main topics, and explains the experiment concisely and well.	Student successfully completes the experiment, records the data, and analyzes the experiment's main topics.	Student either does not complete the experiment successfully, or completes it successfully but does not record the correct data.
Design experiments	Student understands what needs to be tested and designs an appropriate experiment that takes into account the limitations of the equipment and measurement accuracy.	Student understands what needs to be tested and designs an appropriate experiment, but may not fully understand the limitations of the measurements.	Student does not understand what needs to be tested and/or does not design an appropriate experiment.

Rubric for (c)	5 (Excellent)	3 (Average)	1 (Poor)
Design capability and design constraints	Student understands very clearly what needs to be designed and the realistic design constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	Student understands what needs to be designed and the design constraints, but may not fully understand the limitations of the design constraints	Student does not understand what needs to be designed and the design constraints.
Process to meet desired needs	Student understands very clearly the process of the design	Student understands what the needs of the process design, but may not fully understand the limitations of the design constraints	Student does not understand the process.

Rubric for (d)	5 (Excellent)	3 (Average)	1 (Poor)
Ability to work in teams	Performance on teams is excellent with clear evidence of equal distribution of tasks and effort as well as frequent meetings of the team members.	Performance on teams is acceptable with one or more members carrying a larger amount of the effort as well as infrequent meetings of the members or one or more members being absent from several meetings.	Performance on teams is poor to unacceptable with one or two members clearly carrying the majority of the effort as well as inadequate team meeting or one or more members missing the majority of the meetings.
Multi-disciplinary teams	Team consists of members from two or more different engineering/science/business fields (this could contain some members not actually enrolled in the course but interacting as part of a competition, collaboration, etc.)	Team consists of members from two or more concentrations within the Department of Electromechanical Engineering	Team consists of members from the same concentration within the Department of Electromechanical Engineering

Rubric for (e)	5 (Excellent)	3 (Average)	1 (Poor)
Identify applications in engineering systems	Students understand problem and can identify fundamental formulation	Students understand problem but cannot apply formulation.	Students cannot identify correct terms for engineering applications
Modeling, problem formulation and problem solving	Students choose and properly apply the correct techniques	Students model correctly but cannot select proper technique or model incorrectly but solve correctly accordingly	Students at loss as to how to solve a problem

Rubric for (f)	5 (Excellent)	3 (Average)	1 (Poor)
Design	Understand how to critique and analyze design tradeoffs and constraints with respect to safety, liability, and integrity of data, and context of use	Have knowledge of safety, liability, and integrity of data, and context of use but cannot analyze thoroughly	No awareness of importance of safety, liability, and integrity of data, and context of use
Professional Engineering Practice	Understand how to critique and analyze tradeoffs and constraints with respect to research issues of credit and authorship, integrity of data, and informed consent	Have knowledge of credit and authorship, integrity of data, and informed consent but cannot completely identify ownership in practical	No awareness of credit and authorship, integrity of data, and informed consent
Group Relations	Understand how to critique and analyze tradeoffs and constraints with respect to conflict of interest, bribery, professional dissent, authorship, and discrimination	Have partial knowledge of conflict of interest, bribery, professional dissent, authorship, discrimination but cannot apply it in practice correctly	No awareness of conflict of interest, bribery, professional dissent, authorship, and discrimination

Rubric for (h)	5 (Excellent)	3 (Average)	1 (Poor)
Scope of Content	Students will demonstrate material, items, or topics characterized by a sophisticated array of information, insight, and understanding.	Students demonstrate significance reflecting an acceptable degree of perception and thoughts.	Students have limited abilities to relate, incorporate, or demonstrate knowledge of subject with a dynamic breadth.
Impact of Process	Students will employ techniques, designs, ideas, and knowledge demonstrating a profound ability to improve and possess broad applications with a keen a series of actions, changes, or functions	Techniques, designs, ideas, and knowledge present some understanding and ability to demonstrate progression, significance, and influence.	Techniques, designs, ideas, and knowledge present limited progression, significance, and influence

Rubric for (j)	5 (Excellent)	3 (Average)	1 (Poor)
Relevance to the Present Time	Student displays an understanding of the theoretical or practical impact and an ability to correlate a subject, perception, communication, association and reasoning from a global and societal perspective.	Student is able to display an understanding of current topics and issues with some knowledge regarding their impact in a bigger global and societal sense.	Student has difficulty demonstrating an awareness or familiarity with current topics and issues relevant to most current global and societal affairs.

Rubric for (k)	5 (Excellent)	3 (Average)	1 (Poor)
Use modern hardware tools in engineering practice	Student uses the hardware to measure and/or build engineering systems/designs correctly, and understands the limitations of the hardware.	Student uses the hardware to measure and/or build engineering systems/designs correctly.	Student does not use the hardware correctly.

Rubric for (l)	5 (Excellent)	3 (Average)	1 (Poor)
Use modern computer and software tools in engineering practice	Student uses the computer and software to correctly analyze engineering problems and/or create engineering designs, and understands the limitations of the software.	Student uses the computer and software to correctly analyze engineering problems and/or create engineering designs.	Student does not use the computer and software to correctly create engineering designs and/or does not correctly interpret the results.