University of Macau
Department of Electromechanical Engineering
MECH305 - Product Design I
Syllabus
1st Semester 2011/2012
Part A – Course Outline

Compulsory course in Electromechanical Engineering

Course description:

In this course, fundamentals and principles of kinematics and kinetics of particles and rigid bodies will be studied, and this study enables students to conduct mechanical design from a perspective of dynamics. This course introduces energy and momentum conservation methods and their engineering applications. A design project will also be included to help students to apply the dynamics in practical design applications.

Prerequisites:

MECH204 - Mechanics of Materials

Textbook(s)

- F. P. Beer, F. R. Johnston. ***Vector Mechanics for Engineers: Dynamics***, 7th edition. McGraw-Hill, 2004.

References:

- George Ellwood Dieter, Engineering Design: A Materials and Processing Approach, 4th edition. McGraw-Hill Higher Educatio Press, 2008.
- Jerry Ginsberg, Engineering Dynamics, 3rd edition. Cambridge University Press, 2007.

Course objectives:

1. Introduce to students applications of dynamics in mechanical design. [a, c, j]
2. Introduce to students mathematical modeling the dynamics of physical systems. [a, e]
3. Enable students understand of practical measurements and numerical simulation of dynamics problems. [b, l]

Topics covered:

1. **Kinematics of particles** – Rectilinear motion, curvilinear motion, displacement, velocity, acceleration.
2. **Kinematics of particles** – Newton's second law of motion, linear momentum, angular momentum.
3. **Kinetics of particles** – Work of a force, kinetic and potential energy, conservation of energy.
4. **Kinetics of particles** – Principles of impulse and momentum, impact between particles.
5. **Systems of particles** – Linear and angular momentum of a system of particles, mass center.
6. **Systems of particles** – Kinetic energy of a system of particles, work and energy principle of a system of particles, impulse and momentum of a system of particles.
7. **Kinematics of rigid bodies** – Translation, rotation, absolute and relative velocity, absolute and relative acceleration, coriolis acceleration, rate of change of vector relative to a moving or rotating frame.
8. **Plane motion of rigid bodies** – Equations of motion, angular momentum of rigid body, systems of rigid bodies
9. **Plane motion of rigid bodies** – Principles of work and energy for a rigid body, work of forces, kinetic energy of a system of rigid bodies, impulsive motion.
10. **Kinetics of rigid bodies in 3-D motion** – Angular momentum, kinetic energy, rotation of a rigid body about a fixed point or fixed axis.
11. **Mechanical design and analysis** – Engineering design with using engineering drawing, design functional analysis, design with mechanism dynamics analysis, design prototype making and assembly.

Class/practice schedule:

Timetabled work in hours per week			No of teaching weeks	Total hours	Total credits	No / Duration of exam papers
Lecture	Tutorial	Practice				
3	0.3	0.7	14	56	3	1 / 2 hours

Contribution of course to meet the professional component:

This course prepares students to work professionally in the area of **mechanical design** and **dynamics**.

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.

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.

(j) A knowledge of contemporary issues.

(l) An ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations.

Course content:

Maths	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies	Total 100%
30	0	30	30	0	10	100

Persons who prepared this description:

Dr. Zhengchao Xie

Part B – General Course Information and Policies

1st Semester 2011/2012

Instructor: Dr. Zhengchao Xie
Office: B1-B810
Office Hour: By appointment
Phone: (853) 8471
Email: zxie@umac.mo

Time/Venue:
TBA

Assessment:
Final assessment will be determined on the basis of:

Homework:	15%
Mechanical design project (group project):	15%
Mid-term I:	35%
Final Exam (Comprehensive):	35%

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

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

- 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.

Mid-term Exams:
One mid-term exam will be held in the middle of the semester.

Note:

- Attendance is strongly recommended.
- Check UMMoodle (webcourse.umac.mo) for announcement, homework and lectures.
- 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 (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 (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 (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.