University of Macau
Department of Electromechanical Engineering
MECH102 - Applied Mechanics
Syllabus
1st Semester 2011/2012
Part A – Course Outline

Compulsory course in Electromechanical Engineering

Course description:

Statics of Particles, Rigid Bodies: Equivalent System of Forces, Equilibrium of Rigid Bodies, Distributed Forces: Centroids and Centers of Gravity, Analysis of Structures, Forces in Beams and Cables, Friction, Distributed Forces: Moments of Inertia, Virtual Work

Prerequisites:

- None

Textbook(s) and other required material:

- Ferdinand P. Beer, E. Russell Johnston Jr., David F. Mazurek, & Elliot R. Eisenberg, ***Vector Mechanics for Engineers: Statics***, 8th Ed., McGraw-Hill, 2007 (Required)

References:

- J. L. Meriam & L. G. Kraige, *Engineering Mechanics – Statics*, 6th Ed., John Wiley & Sons, 2006
- William F. Riley & Leroy D. *Sturges*, *Engineers Mechanics: Statics*, John Wiley & Sons

Course objectives:

1. Understand the basic concepts of forces, moments, couples, free body diagrams, and static equilibrium in 2-D and 3-D. [a, e, g]
2. Develop strategies to analyze the statics of particles and rigid bodies. [a, e, g]
3. Apply the laws of statics to analyze forces in structures, beams, and cables. [a, e, g]
4. Familiarity with centroids, friction, moment of inertia. [a, e, g]

Topics covered:

1. **Introduction -** Fundamental concepts and principles of engineering mechanics
2. **Statics of Particles -** Forces in a plane and space; Vectors; Vector addition; Resultant of several concurrent forces; Resolution of a Force into Components; Equilibrium of particle in plane and in space;
3. **Equivalent systems of forces in rigid bodies -** Vector Product; Moment of a forces about a point; Scalar Product; Mixed Triple Product ; Moment of a force about a given axis; Moment of a couple; Reduction of a System of forces into One Force and One Couple; Equivalent systems of forces
4. **Equilibrium of rigid bodies** - Free Body Diagram; Equilibrium in two dimensions; Two-force body; Three-force body; Equilibrium in three dimensions
5. **Distributed Forces -** Centroids of areas and lines; Center of gravity areas and lines; Composite Plates and wires, Determination of Centroids by Integration; Theorem of Pappus-Guldinus; Center of gravity of 3-D Body; Composite Bodies; Determination of Centroids of Volumes by Integration
6. **Analysis of Structures -** Trusses; Method of joints; Method of sections; Frames; Machines
7. **Forces in Beams and Cables -** Internal forces in Members; Concentrated loads; Distributed loads;
8. Shear and Bending Moment; Cables with Concentrated and Distributed loads; Parabolic Cable
9. **Friction -** Dry friction; coefficients of friction; angle of friction; wedges; Belt friction
10. **Moments of inertia -** Moment of inertia of areas; Determination of moment of inertia by Integration;
11. Polar Moment of inertia; Radius of Gyration of an Area; Parallel-axis Theorem; Moment of inertia of Composite Areas; Moment of inertia of masses
12. **Virtual work** – Work of a Force; Principle of Virtual Work; Application of the Principle o Virtual Work

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				
3.5	1.5	0	14	70	4	1 / 3 hours

Topic Outline:

Week	Date	Tentative Lecture / Topic	Reading
			Beer
1	8/30	Introduction to mechanics, forces in plane	§1.1-§1.6
	9/2	Vector addition , Resultant of forces, forces in space	§2.1-§2.7
2	9/6	Equilibrium of particle in plane, Equilibrium of particle in space	§2.8-§2.15
	9/9	Vector Product, Moment of a forces about a point, Scalar Product	§3.1-§3.6
3	9/13	**Holiday: The Day following Mid-Autumn Festival – No class**	
	9/16	Mixed Triple Product, Moment of a force about a given axis,	§3.7-§3.15
4	9/20	Moment of a couple, Reduction of a System of forces into One Force and One Couple, Equivalent systems of forces	§3.16-§3.20
	9/23	**Quiz – Statics of Particles**	
5	9/27	Free-body diagram	§4.1-§4.2
	9/30	Equilibrium in two dimensions, Two-force body	§4.3-§4.6
6	10/4	Three-force body, Equilibrium in three dimensions	§4.7-§4.9
	10/7	Centroids of areas and lines, Center of gravity of areas and lines; Composite Plates and wires, Determination of Centroids by Integration	§5.1-§5.6
7	10/11	**Mid-Term – Equivalent systems of Forces, Equilibrium of particles and rigid bodies**	
	10/14	Theorem of Pappus-Guldinus, Center of gravity 3-D Body, Composite Bodies, Determination of Centroids of Volumes by Integration	§5.7 §5.10-§5.12
8	10/18	Structures, Trusses: method of joints	§6.1-§6.3
	10/21	Trusses: method of sections	§6.4 §6.7
9	10/25	Frames and Machines	§6.9-§6.12
	10/28	Internal forces in Members, Forces in Beams, Concentrated loads	§7.1-§7.2
10	11/1	Distributed loads, Shear and Bending Moment	§7.3-§7.6
	11/4	Cables with Concentrated and Distributed loads, Parabolic Cable	§7.7-§7.9
11	11/8	**Quiz – Centroids and Analysis of structure**	
	11/11	Dry friction, coefficients of friction, angle of friction	§8.1-§8.4
12	11/15	Wedge, Belt friction	§8.5 §8.10
	11/18	Moment of inertia of areas, Determination of moment of inertia by Integration	§9.1-§9.5
13	11/22	Polar Moment of inertia, Radius of Gyration of an Area, Parallel-axis Theorem, Moment of inertia of Composite Areas	§9.6 §9.7
	11/25	Moment of inertia of masses	§9.11-§9.15
14	11/29	Work of a Force, Principle of Virtual Work	§10.1-§10.3
	12/02	Application of the Principle o Virtual Work	§10.4
15	12/4-8	**Study Period**	
15, 16	12/9-19	**Final Exam**	

Contribution of course to meet the professional component:

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

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.
(e) an ability to identify, formulate, and solve engineering problems.

The course secondarily contributes to Electromechanical Engineering Programme outcomes that develop student abilities to:
(g) an ability to communicate effectively.

Course content:

Maths	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies	Total 100%
10	10	50	20	5	5	100

Persons who prepared this description:

Prof. Vai Kuong Sin

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Part B – General Course Information and Policies

1st Semester 2011/2012

Instructor: Prof. Vai Kuong Sin Office: N318
Office Hour: MW 3:30 – 5:30PM or by appointment Phone: (853) 8397-4368
Email: vksin@umac.mo

Time/Venue:

Every Tuesday, 9:30 a.m. – 11:30 p.m., Room ILG126 (Lecture)
Every Wednesday, 8:30 p.m. – 9:30 p.m., Room ILG126 (Tutorial)
Every Friday, 9:30 p.m. – 11:30 p.m., Room ILG126 (Tutorial + Lecture)

Assessment:

Final assessment will be determined on the basis of:

Homework:	15%
In-class Quizzes:	15%
Mid-term:	30%
Final Exam:	40%

Grading System:

This 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:

All students are expected to attend all lectures, quizzes, and examinations. Although classroom attendance does not mathematically contribute to the final course grade, active class participation is expected of all students and may help to boost up the course grade in those "borderline cases" between failing and passing. It is your responsibility to read the relevant chapters in the text before and after class and to ask questions during class discussion. In order to be successful in this course, you should get as much practice as possible in solving problems outside the class hours. This must be done on a timely and regular basis, as a good understanding of the material covered in any particular section of this course depends heavily on an equally good understanding of the material covered in previous sections.

Homework Policy:

All homework must be an individual effort unless specifically noted. Your work must be neat, with answers clearly noted and supporting information provided. Late homework will not be accepted in general.

Quizzes:

Quizzes will be closed book and notes. The format will primarily be problems that are similar to homework problems.

Note:

- Cheating in any form will not be tolerated. STUDENTS WHO CHEAT ON ANY ASSIGNMENT, OR DURING ANY QUIZ OR EXAMINATION WILL BE ASSIGNED A FAILING GRADE FOR THE COURSE AND MAY RESULT IN SUSPENSION OR EXPULSION FROM THE UNIVERSITY. Therefore avoid all appearance of improper behavior. Students who witness cheating should report the incident to the instructor as soon as possible.
- Photocopies of the textbooks are illegal and are violation of the Macao copyright laws.

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 (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 (g)	5 (Excellent)	3 (Average)	1 (Poor)
Professional Impact	Student's/Team's/Group's document(s)/presentation(s) is/are considered to be of professional quality	Student's/Team's/Group's document(s)/presentation(s) is/are considered acceptable for college level work	Student's/Team's/Group's document(s)/presentation(s) is/are considered unacceptable for college level work
Written Component	Document is nearly error free with sophisticated use of vocabulary, formatted properly, with well developed concise sentences and paragraphs	Document contains some errors with a somewhat colloquial vocabulary, minor formatting issues, with some organizational issues that do not interfere with communication	Document contains many errors, very colloquial vocabulary, with severe organizational issues that interfere with communication. Document would be considered unacceptable.
Oral Component	Presentation is consistent, uniform, clear, direct, complete and captivating with very clear fonts and graphics with an excellent layout that clearly presents the technical content	Presentation is somewhat inconsistent between speakers, occasionally difficult to hear, with an acceptable layout containing acceptable fonts and graphics that adequately presents the technical content	Presentation is very inconsistent between speakers, difficult to hear with a poor layout containing illegible fonts and graphics that poorly presents the technical content. Would be considered unacceptable