University of Macau
Department of Electromechanical Engineering
MECH103 - Structure & Properties of Materials
Syllabus
2nd Semester 2010/2011
Part A – Course Outline

Compulsory course in Electromechanical Engineering

Course description:
Atomic structure and interatomic bonding. Crystalline and noncrystalline structures. Defects and imperfections in solids. Diffusion and crystallization. Mechanical properties. Strengthening mechanisms: solid-solution hardening, deformation hardening and annealing, Failure, Phase diagrams.

Prerequisite:
None

Textbook:
- W. D. Callister, ***Materials Science and Engineering: An Introduction,*** 7th Edition, Addison-Wesley 2006

Reference:
- William F. Smith, Javad Hashemi, ***Foundations of Materials Science and Engineering***, 5th Edition. McGraw Hill, 2009

Course objectives:
1. Introduce students to fundamental knowledge in materials science and engineering [a]
2. Introduce students to use the techniques, skills, and engineering tools necessary for engineering practice [e, k]

Topics covered:
1. **Introduction to Materials Science and Engineering** – Historial perspective, classification of materials
2. **Atomic Structure and Interatomic Bonding** – Atomic structure & bonding, boding forces & energies, primary & secondary bonds
3. **The Structure of Crystalline Solids** – Unit cells, Metallic crystal structures, density computations, polymorphism & allotropy, Crystallographic directions & planes, linear & planar densities, crystalline & amorphous materials, single crystals & polycrystalline materials, X-ray diffraction
4. **Defects in Solids** – Point, linear (dislocations), interfacial & volume defects, microscopy, grain size determination
5. **Diffusion in solid** – Diffusion mechanisms steady and nonsteady-state diffusion, Influencing factors
6. **Mechanical Properties of Metals** – Engineering stress & strain, elastic & plastic deformation, Young modulus, yield & tensile strengths, ductility, toughness, Poisson's ratio, hardness, true stress & strain, tensile & hardness testing, safety factors
7. **Dislocations and Strengthening Mechanisms** – Slip systems, strengthening mechanisms (grain size reduction, solid solution hardening, strain hardening), recovery, recrystallization & grain growth
8. **Failure** – Ductile & brittle fracture, impact testing, fatigue, creep
9. **Phase Diagrams** – Solubility limit, phases, microstructure, binary phase diagrams, eutectic & peritectic reactions, lever rule

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				
4	1	0	14	70	5	1 / 3 hours

Contribution of course to meet the professional component:

This course prepares students to work professionally in the area of **materials science and engineering**.

Relationship to EME program objectives and outcomes:

This course primarily contributes to Electromechanical Engineering Program outcomes that develop student abilities to:
(a) an ability to apply knowledge of mathematics, science, and engineering.

The course secondarily contributes to Electromechanical Engineering program outcomes that develop student abilities to:
(e) an ability to identify, formulate, and solve engineering problems.
(k) an ability to use the techniques, skills, and modern engineering tools/equipments necessary for engineering practice.

Course content:

Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies	Total 100%
40	40	20	0	0	100

Course modulator:

Dr. Kin Ho Lo

Persons who prepared this description:

Prof. Chi Tat Kwok, Dr. Kin Ho Lo, Prof. Vai Kuong Sin

Part B General Course Information and Policies

2nd Semester 2010/2011

Instructor: Prof. Chi Tat Kwok
Office: N409
Office Hour: By appointment
Phone: (853) 8397-4459
Email: fstctk@umac.mo

Time/Venue:

Every Tuesday, 4:00 p.m. - 7:00 p.m., Room J217
Every Thursday, 8:30 a.m. - 10:30 a.m., Room J217

Assessment:

Final assessment will be determined on the basis of:

Homework:	20%
Lab report:	10%
Mid-term:	20%
Final Exam (Comprehensive):	50%

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, 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 7 homework assignments.
- Homework is due two weeks after assignment unless otherwise noted, for late homework submitted not later than 3 days; marks will be deducted by 30%.
- Possible revision of homework grades may be discussed with the grader within one week from the return of the marked homework
- The course grade will be based on the average of the homework grades.

Quizzes/Mid-terms Exams:

One mid-term exam will be held during the semester.

Note:

- Recitation session is important part of this course and attendance is strongly recommended.
- 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 Program 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 (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.