UNIVERSITY OF MACAU
DEPARTMENT OF ELECTROMECHANICAL ENGINEERING
CHEM101 - Chemistry
Syllabus
1st Semester 2010/2011
Part A – Course Outline

Compulsory course in Electromechanical Engineering

Course description:
This one-semester course is for first year students of Department of Electromechanical Engineering. Its contents are comparable to those chemistry courses offered by universities in Portugal/United States. It deals with atoms and molecules, periodic table, electronic structure, chemical bondings, chemical reactions, electrochemistry and organic chemistry.

Prerequisite:
None

Textbook:
- Julia Burdge, ***Chemistry***, 2nd Edition, McGraw Hill, 2009, ISBN: 978-0-07-122183-2

Reference:
- Raymond Chang, ***Chemistry***, 10th Edition, McGraw Hill, 2010, ISBN: 978-0-07-017264-7

Course objectives:
1. Introduce to students applications of chemistry in modern materials while developing student understanding abstract, microscopic concepts. [a]
2. Students conduct experimental work to consolidate and to complement theories learnt in (or prior to) lectures. [a, b, c, e]
3. Building problem solving skills. [a, e]

Topics covered:
1. **Atoms and molecules** – Review basic concepts of atoms, molecules, and electrons; introduction to quantum chemistry.
2. **Periodic table, electronic structure** – Elemental properties and trends in periodic table.
3. **Chemical bonding** – Covalent, ionic bonding; electronegativity; Lewis structure & formal charges; Octet rules.
4. **Gases, solutions, and solids** – Gas law; Kinetic molecular theory of gas; intermolecular forces; crystal structure; phase diagrams; concentration units; colligative properties.
5. **Reaction kinetics and chemical equilibrium** – Reaction rates; collision theory; reaction mechanism; catalysis, concept of equilibrium; Le Châtelier's principle, acids and bases equilibrium; common ion effect; acid-base titration; solubility equilibria.
6. **Thermodynamics and electrochemistry** – Entropy; law of thermodynamics; Gibbs free energy and chemical equilibrium; redox reaction; spontaneity of redox reactions; batteries; electrolysis; corrosion.
7. **Organic chemistry & modern materials –** Classes of organic compounds; isomerism; organic reactions; organic polymers; ceramics; liquid crystals; nanotechnology; semiconductors; superconductors.
8. **Nuclear chemistry –** Nuclear stability; natural radioactivity; nuclear transmutation; nuclear fission; nuclear fusion; uses of isotopes.

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	0	3	14	84	4	1 / 3 hours

Topic Outline:

Week No.	No. of hours	Topics
1	3	**Atoms and molecules** Review basic concepts of atoms, molecules, and electrons; introduction to quantum chemistry.
2	3	**Periodic table, electronic structure** Elemental properties and trends in periodic table.
3, 4	6	**Chemical bonding** Covalent, ionic bonding; electronegativity; Lewis structure & formal charges; Octet rules
5 – 7	9	**Gases, solutions, and solids** Gas law; Kinetic molecular theory of gas; intermolecular forces; crystal structure; phase diagrams; concentration units; colligative properties.
8 – 10	9	**Reaction kinetics and chemical equilibrium** Reaction rates; collision theory; reaction mechanism; catalysis, concept of equilibrium; Le Châtelier's principle, acids and bases equilibrium; common ion effect; acid-base titration; solubility equilibria.
11 – 12	6	**Thermodynamics and electrochemistry** Entropy; law of thermodynamics; Gibbs free energy and chemical equilibrium; redox reaction; spontaneity of redox reactions; batteries; electrolysis; corrosion.
13 – 14	6	**Organic chemistry & modern materials** Classes of organic compounds; isomerism; organic reactions; organic polymers; ceramics; liquid crystals; nanotechnology; semiconductors; superconductors.
15	3	**Nuclear chemistry** Nuclear stability; natural radioactivity; nuclear transmutation; nuclear fission; nuclear fusion; uses of isotopes.

Contribution of course to meet the professional component:

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

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.
(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;

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

(b) an ability to design and conduct experiments, as well as to analyze and interpret data.
(e) an ability to identify, formulate, and solve engineering problems.

Course content:

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

Course modulator:

Prof. Pak Kin Wong

Persons who prepared this description:

Dr. Weng Fai Ip, Prof. Pak Kin Wong

Part B – General Course Information and Policies

1st Semester 2010/2011

Instructor:	Dr. Weng Fai Ip	Office:	N305
Office Hour:	By appointment	Phone:	(853) 8397-4355
Email:	andyip@umac.mo		

Time/Venue:

Lecture: Every Wednesday, 9:30 a.m. - 10:30 a.m., Room U103
Every Friday, 5:30 p.m. - 7:30 p.m., Room U103
Laboratory: [Session 1] Every Monday, 8:30 a.m. - 11:30 a.m., W102
[Session 2] Every Monday, 2:30 p.m. – 5:30 p.m., W102

Assessment:

Final assessment will be determined on the basis of:
Assignment and class quizzes: 10%
Laboratory: 30%
Mid-term Exam: 20%
Final Exam (Comprehensive): 40%

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.

Homework Policy:

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

- Laboratory report is due one week after conducting the corresponding experimental work unless otherwise noted, penalty is applied to late submission.
- The coursework grade (60% of total) is the summation of grades in assignments and class quizzes, mid-term exam and laboratory.

Quizzes/Mid-term Exam:

One (1-hour) mid-term exam will be held during the semester. There will be a 15-miniutes in class exam during the progress of the course.

Note:

- No make-up exam is given except for CLEAR medical proof.
- Cheating is absolutely prohibited by the university. Copying in laboratory report is considered an infringement of academic integrity.

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 (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