
SYLLABUS

Date/ Revision 18 July 2016/03

Faculty Engineering

Approval

SUBJECT : APPLIED CHEMISTRY AND MATERIAL SCIENCE

1. Identification of Subject:

Name of Subject :Material Science
Code of Subject :MATL 1100
SKS :3
Semester :1
Study Program :AVE, ELE, INE, MEE
Lecturer :Mirza Rizky Zulkarnain MSc., Runita Riskiyanti Putri, MSc., Dipl.-Ing. Wahjoe Goeritno M.Si

2. Competency

After having the course, students are expected to:

- Understand and be able to explain the general principles, laws, and theories of chemistry
- Use critical thinking and logic in the solution of problems
- Apply learned chemistry skills to new situations
- Demonstrate an understanding of basic chemistry
- Have the basic knowledge of chemistry and its application.
- Have basic knowledge of selecting material for certain application by knowing its properties
- Have the knowledge of crystal structure that build the material
- Be able to do simple calculation in diffusions of carbon in Steel.
- Be able to read and understand the Steel phase diagram.
- Have the knowledge of steel application and processing.
- Understand the polymers: the built of polymer, properties, application and processing

3. Description of Subject:

This course is intended for students who do not have a materials science and engineering background. The course will cover four major topics including: fundamental concepts, microstructure development and phase equilibria, material properties and fabrication methods and applications. The course will cover atomic structure, atomic bonding, crystal structures, defects, and diffusion in materials. It also will cover phase equilibria and how they impact microstructure development. The electrical, magnetic, optical, thermal, and mechanical properties of materials will also be reviewed. The course will also highlight modern fabrication technologies and applications of metals, ceramics, semiconductors, and polymers.

4. Learning Approach

Approach : Combination of Expository - inquiry and collaborative
Method : Discussion, question answer, sample problem, group work
Student Task : Home work, presentation
Media : LCD projector, film.

5. Evaluation

- a) Absence maximum : 25%
 b) Participation in discussion : 5 points
 c) Homework, Classwork : 5 points
 d) Presentation, Simulation : 10 points
 e) Daily Quiz : 20 points
 f) Final Examination : 60 points

Total : 100 points

6. Contents/ Topics of Lecturing:

Week	Topics	Content	Remark
1	Atoms, Molecules, and Compounds	Fundamental Chemical Laws, Atomic theory, Atomic Models, Radioactivity, Atomic Symbol, Chemical Bonds, Periodic Table, Naming various types of compounds, Formulas, Acids	Lecture, Group discussion, tutorial for exercise Chapter 1 and Chapter 2 (Zumdahl)
2	Atomic Structure & Periodicity	Structure of atoms, electron configuration and electron orbitals, quantum numbers, periodic table, atomic and ionic radii, ionization energy & Electron affinity	Lecture, Group discussion, tutorial for exercise Chapter 2 and 3 (Zumdahl)
3	Basic Concepts of Chemical Bonding, Molecular Geometry and Bonding Theories	Type of bondings (Covalent, ionic, coordination, metallic bondings), electron sharing and Electron transfer, Bond Polarity, Lewis Structure, octet rules, resonance, formal charge	Lecture, Group discussion, tutorial for exercise Chapter 4 (Zumdahl)
4	Stoichiometry: Calculations with Chemical Formulas and Equations	Law of Conservation of Mass, Chemical equations, reactions types, formula weight, Moles, Finding Empirical Formulas, Limiting Reactants, & tutorial	Lecture, Group discussion, tutorial for exercise Chapter 9 (Zumdahl)
5	Electrochemistry	Redox reaction, balancing redox reaction, standard reduction potential (E°), galvanic cell, cell potential, battery, corrosion phenomena	Lecture, Group discussion, tutorial for exercise Chapter 11 (Zumdahl)
6	Structure of Metals	Crystal structure SC, FCC, BCC, HCP. Atomic packing factor, Density calculation. Crystal System Cubic, Tetragonal, Orthorhombic. Single crystal, Poly crystal, Crystalline and Non Crystalline.	Ch3, ch4.
	Defect in Solids	Vacancies and Self interstitial, Impurities in Solids. Dislocation – Linear Defect, Interfacial, bulk and Volume defect.	Ch6

7	Diffusions	Diffusion mechanism, Steady State Diffusions, Non Steady State Diffusions, Factor influencing the Diffusion.	Ch.7
8	Mechanical Properties of Metal	Concept of Stress and Strain, Stress Strain behaviour, Elastic deformation, plastic deformation. Tensile, Shear, Torsional and Hardness.	CH.8 Quiz
9	Failure	Fracture: Fundamental of fracture, ductile fracture, brittle fracture, principle of fracture mechanics, toughness Fatigue: Cyclic stresses, the S-N curve, crack initiation, factor that affect fatigue, environmental effect. Creep: Creep behavior, stress and temperature effect, alloy for high temperature use.	Ch.10
10	Phase Diagrams	Solubility limit, Phases, Phase Equilibria, Binary Isomorphous System, Binary Eutectic System.	Ch.11 Quiz
11	Phase Transformation	The Iron – Carbon System: The Iron – Iron carbide Phase Diagram, Development of Microstructure in Iron – Carbon Alloys, The Influence of other Alloying Elements.	Ch.12
12	Application and Processing of Metal Alloy	Types of Metals Alloys, Ferrous, Non Ferrous Material. Thermal Processing of Metals.	Ch.13 Quiz
13	Polymer Structures:	Hydrocarbon Molecules, Polymer Molecules, Molecule Weight, Thermoplastic and Thermosetting, Copolymer.	Ch.5
	Characteristics, Applications and Processing of Polymer	Mechanical Behaviour of Polymer, Mechanism of Deformation and Strengthening of Polymer, Crystallization, Melting and Glass Transition Phenomena in Polymers, Polymer Types, Polymer Synthesis and Processing.	Ch.15
14	Composite Material	Particle reinforced composites Fiber reinforced composites	Ch.16 Quiz
		Practice how to make composite	Practical
15	Final Examination		

7. Book Reference:

a) **Text Book:**

Material Science and Engineering, an Introduction – William D. Callister, David G. Rethwisch – John Wiley and Sons Inc.

b) Chemistry, Steven S. Zumdahl, Susan A. Zumdahl, 9th Edition, ISBN-13: 978-1133611097, Brooks Cole (Cengage), 2013

Reference:

c) Material Science and Engineering, a First Course – V. Raghavan – PHI Learning Pvt. Ltd.

d) Introduction to Physical Metallurgy, 2 Editions, Author: Avner, S. H., McGraw Hill, New York