

**SYLLABUS, LESSON PLAN, MIDTERM AND FINAL SEMESTER
EXAMINATIONS, HANDOUTS AND WORKSHEETS OF PHYSICAL
CHEMISTRY I**



MILIK PERPUSTAKAAN UNIV. NEGERI PADANG	
TERIMA TGL.	: 22 October 2012
SUMBER HARGA:	Hd
KOLEKSI	: U1
NO. INVENTARIS	: 12A/Hd/2012 - s. 1 (1)
KLASIFIKASI	: 541.307 Amr S:1

Chemistry- PHYSICS - STUDY AND
TEACHING

By:

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**CHEMISTRY DEPARTMENT
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
STATE UNIVERSITY OF PADANG**

2010

**FACULTY OF MATHEMATICS AND SCIENCE
STATE UNIVERSITY OF PADANG**
Jl. Prof. Dr. Hamka, Kampus UNP Air Tawar Padang, 25131, Telp. (0751)7057420

Subject Syllabus
(Semester Plan)

A. General Information			
Subject	: Physical Chemistry 1	Place/Lecture room	: C04
Code	: Kim 001	Lecture time	: 3 hours
Number of Credit	: 3	Consultation Place	: Chemistry Department Office
Study Program	: 2008 ISTE Students	Docents	: 1. Drs. Ali Amran, M.Pd, M.A, Ph.D 2. Deski Beri, S.Si
Department	: Chemistry		

B. Subject Description

1. This course consists of Introduction to physical chemistry, ideal and non ideal gases, kinetic molecular theory of gas, Chemical Thermodynamics, chemical equilibrium, liquids, solutions and Colloids and Surface Chemistry.
2. Lecture Methods
 - a. Individual and grouped assignments
 - b. Students presentations
 - c. Discussions
3. Final Achievement

This course is designed to encourage students to understand the theoretical and empirical concepts of an ideal and non ideal gases, kinetics molecular of gases, solutions, chemical equilibrium, chemical thermodynamics, liquids and colloids and surface chemistry and its applications as well.

References

Compulsary:

1. Adamson, A.W., *Text Book of Physical Chemistry*, John Willey & Sons, New York
2. Adamson, A.W., (1985), *Physical Chemistry of Surfaces*, John Willey & Sons, New York.
3. Atkins, P.W., (2006) *Physical Chemistry (Eighth Edition)*, Oxford Univ. Press, London
4. Bahl, B.S, Tuli, G.D., Bahl, Arun, (1997), *Essentials of Physical Chemistry*, S.Chand & Company Ltd., New Delhi
5. Barrow, Gordon M., (1996) *Physical Chemistry (sixth Edition)*, Mc Graw Hill, Boston
6. Maron, H. Samuel, Putton, Carl F., (1964) *Principles Of Physical Chemistry*, Macmillan Company, New York

Suggest

1. Castellán, W. Gilbert, (1983), *Physical Chemistry (Third Edition)*, Addison-Wesley Publishing Company, Inc. Massachusetts
2. Montimer, Robert G., (2008), *Physical Chemistry (Third Edition)* Elsevier Publishing, Amsterdam

C. Evaluation System (Grading)

1. Criterion
 - a. Lecture Attendance 5%
 - b. Assignment and task 35%
 - c. Contributions in class 10%
 - d. Midterm Exam 25%
 - e. Final Exam 25%
2. Evaluation Instruments
 - a. Essay test
 - b. Test based on observation from out date research
 - c. Problem sheet
3. Performance evaluation
 - a. an ability to communicate concepts and principles in physical chemistry
 - b. an ability to solve problems and exercises
 - c. an ability to design the laboratory prototypes

D. Details of Syllabus

No of week	Basic Competencies	Achievements Indicators	Learning Experiences	Topics/Sub-Topics	Week	References
1	2	3	4	5	6	7
1	Student competence to understand general knowledge of physical chemistry, the important of physical chemistry, and the relation of physical chemistry with chemistry and other sciences.	Students have some knowledge about physical chemistry in general.	Student competence to read and understanding the text books of physical chemistry.	<ul style="list-style-type: none"> Introduction to physical chemistry The definitions of Physical chemistry, the position of physical chemistry among other branch of science and chemistries The Important role of physical chemistry Some physical chemistry term and unit systems, conversion table and some physical and chemical characteristics 	1	C1, C3, S1 & S2
2	Student competence to understand some concepts dealing with ideal and non ideal gases, ideality of gases, ideal gas laws, critical phenomenon, and theoretical background related to gases	Students are able to derive ideal gas laws, Van der Waal equations and using the equations in daily life	<ul style="list-style-type: none"> In addition, he/she also competence to solve problems and design experiment of physical chemistry. Student competence to perform student's personal skills in presenting his/her assignments in front of classroom. 	<ul style="list-style-type: none"> Ideal and non ideal gases Characteristic and properties of gases, Ideal gas law (Boyle, Charles, Gay-Lussac) Some equations related to non ideal gases or real gases Critical Phenomenon, Compressibility factors Non ideal gases, liquefaction of gases Semi empirical equation of Van der Waal, theoretical backgrounds and derivation Problem & Solution 	2	C1, C3, C6, S1 & S2
4	Student competence to understand some concepts dealing with kinetics particle in box, Boltzmann-Maxwell statistics and some application of Maxwell-Boltzmann statistics	Students are able to make a derivation of molecular kinetics of gas in container, Maxwell-Boltzmann statistics and classical mechanics, gas diffusion and using Graham's law in real times problems		<ul style="list-style-type: none"> Kinetics Molecular of gases Classical mechanics of Imaginary particle in a container Kinetics particle in container equations, calculation of a particle velocity/ Boltzmann distribution, and determination of Boltzmann constant Maxwell-Boltzmann statistic mechanics and derivation Mean free-path Gas diffusion and Graham's law Some applications Barometric equations Problem & Solution 	1	C1, C3, S1 & S2

5	Student competence to understand some concepts dealing with chemical thermodynamics, thermodynamics processes, works and using enthalpies	Students are able to use first, second and third law of thermodynamics, free energy and students have an ability to solve some concepts regarding thermodynamics problems	Student competence to read and understanding the text books of physical chemistry. In addition, he/she also competence to solve problems and design experiment of physical chemistry.	<p>Chemical Thermodynamics</p> <ul style="list-style-type: none"> - Thermodynamic terms and basic concepts, variables of thermodynamics - Types of systems - Intensive and extensive properties - Thermodynamic process, reversible and irreversible processes - First law of thermodynamics - Isothermal expansion work; reversible and irreversible - Work efficiency and Carnot circles - Enthalpy of a system - Second law of thermodynamics - Spontaneous and non spontaneous reactions, free energy - Third law of thermodynamics - Problem & Solution 	2	C1, C3, C6, S1 & S2
7	Student competence to understand some concepts regarding thermo chemistry, the heat and enthalpies	Students are able to use thermo chemistry equations to real times problems, C_v , C_p , heats. Students are able to make a design of experiments based on calorimetric measurements	Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	<p>Thermo chemistry</p> <ul style="list-style-type: none"> - Changes in state at constant Volume and Temperature - The relation between C_p and C_v - Thermodynamics application to chemical reactions, the heat of reaction - The formation reaction - Conventional values of molar enthalpies - The determination of heats of formation - Sequences of reactions: Hess's law - Heats of solution and dilution - Heat of reaction at constant pressure and volume - Bond enthalpies - Calorimetric measurements - Problem & Solution 	1	C3, C6 & S1
8				<p>Mid Term Exams</p> <p>Chemical Equilibrium</p> <ul style="list-style-type: none"> - Definitions - Thermodynamics of equilibrium - K_p and K_c properties and calculations - Homogeneous reaction equilibrium 		
9	Student competence to understand some concepts dealing with chemical equilibrium, hetero- and homogeneous	Students are able to use some equations in chemical equilibrium to real times problems	Student competence to read and understanding the text books of physical chemistry.		2	C4, C6, S1 & S2

	reaction		In addition, he/she also competence to solve problems and design experiment of physical chemistry. Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	<ul style="list-style-type: none"> - Equilibrium in gas states - Equilibrium in liquid states - Temperature dependence - Heterogeneous reaction equilibrium - The equilibrium constant for heterogeneous reactions - Effects of pressure/temperature on heterogeneous equilibrium - Distribution law - Problem & Solution 		
10	Student competence to understand some concepts dealing with liquids, liquids dynamics and some physical properties of liquids	Students have some knowledge in liquids, liquids physical properties and having some knowledge in measurements of surface tension, viscosity, refractive index and optical activity	Student competence to read and understanding the text books of physical chemistry. In addition, he/she also competence to solve problems and design experiment of physical chemistry. Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	<ul style="list-style-type: none"> - Liquids - Critical Phenomena in liquids - P-V-T relations - Van der Waal relations on liquefaction of gases - Kinetic molecular description - Intermolecular forces in liquids - Vapor pressure - Measurements of vapor pressure - Surface tension of liquids - Measurements of surface tension - Viscosity of liquids - Measurements of viscosity - Refractive index - Measurements of refractive index - Optical activity - Measurements of optical activity - Problem & Solution 	2	C4, C6, S1 & S2
12	Student is able to describe the terms of solutions, ideal solutions and Raoult's law, miscibility of mixtures and distillation principles	Student competence to understand some knowledge in solutions, solubility, and miscibility. Students are having some knowledge in liquids mixture,	<ul style="list-style-type: none"> - Solutions - Definition - Factors affecting solubility - Kinds of Solutions - Ideal Solutions and Raoult's Law - Miscibility (Complete Binary and Ternary Mixtures) 	2	C4, C6, S1	

		curvature of miscibility and principles of distillations and azeotropic mixtures. Students are able to explain the curvature and to make calculations.			<ul style="list-style-type: none"> - Miscibility of partial solutions - Azeotropic Mixtures Distillations and principle of distillations - Colligatives properties - Lowering Vapor pressures by small addition of solute - Boiling point elevation of solutions - Calculation of molecular weights from boiling point elevation - Problem & Solution 		
14	Student competence to understand some concepts and theoretical background of osmotic pressure.	Students are able to make calculations of osmotic pressure. Students are able to describe membrane, determination of molecular weight from osmotic pressure.	Student competence to read and understanding the text books of physical chemistry.	<ul style="list-style-type: none"> - Osmotic pressures - Diffusion and osmosis - Osmosis and osmotic pressure - Vant Hoff's equation for osmotic pressure - Semi permeable membrane - Determination of osmotic pressure - Isotonic solutions - Determination of molecular weight from osmotic pressure - Relation between vapor pressure and osmotic pressure - Osmotic pressure of electrolytes - Problem & Solution 	1	C2, C3, C4	
15,16	Student competence to understand some concepts about colloids dispersion, association colloids and the relation of colloids and surface phenomenon	Students are able to describe the colloids dispersion, colloidal systems, colloids properties, association colloids. Students are able to describe colloidal synthesis and able to design problem solving in real times problems.	Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	<ul style="list-style-type: none"> - Colloids and surfaces chemistry - Colloidal dispersions - Types of Colloidal Systems - Soils - Preparations of Soils - Properties of Soils - Association of Colloids - Miscelle properties - Emulsion - Application of Colloids - Problem & Solution 	1	C2,C3, C4, S1 & S2	
17				Final Exams			

LESSON PLAN OF PHYSICAL CHEMISTRY 1

LESSON PLAN

Department : Chemistry
Subject Title : Physical Chemistry 1 (Chem. 002)
Topic : Introduction to Physical Chemistry
Program : 2008 ISTE Students
Lecture Time : 3 X 50 minutes
Schedule : First week

I. Basic Competency

Student competence to understand general knowledge of physical chemistry, the important of physical chemistry, and the relation of physical chemistry with chemistry and other sciences.

II. Indicator

Students have some knowledge about physical chemistry in general.

III. Topics/Sub-Topics

Introduction to physical chemistry: a) The definitions of Physical chemistry, the position of physical chemistry among other branch of science and chemistries, b) The important role of physical chemistry Some physical chemistry term and unit systems, conversion table and some physical and chemical characteristics.

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations
3. Discussions

V. Learning Process

Number	Activities	Time
1	Individual and grouped assignments a) Student competence to read and understanding the text books of physical chemistry. b) In addition, he/she also competence to solve problems and design experiment of physical chemistry.	
2	Students Presentations Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	
3	Discussions Lecturer ask the students to answer one or two questions to check their understanding about the concepts	

VI. Evaluation

- a. an ability to communicate concepts and principles in physical chemistry
- b. an ability to solve problems and exercises
- c. an ability to design the laboratory prototypes

LESSON PLAN

Department	: Chemistry
Subject Title	: Physical Chemistry I (Chem. 001)
Topic	: Ideal and non ideal gases
Program	: 2008 ISTE Students
Lecture Time	: 3 X 50 minutes
Schedule	: Second and third weeks

I. Basic Competency

Student competence to understand some concepts dealing with ideal and non ideal gases, ideality of gases, ideal gas laws, critical phenomenon, and theoretical background related to gases

II. Indicator

Students are able to derive ideal gas laws, Van der Waal equations and using the equations in daily life.

III. Topics/Sub-Topics

Ideal and non ideal gases

1. Characteristic and properties of gases,
2. Ideal gas law (Boyle, Charles, Gay-Lussac)
3. Some equations related to non ideal gases or real gases
4. Critical Phenomenon, Compressibility factors
5. Non ideal gases, liquefaction of gases
6. Semi empirical equation of Van der Waal, theoretical backgrounds and derivation
7. Problem & Solution

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations
3. Discussions

V. Learning Process

Number	Activities	Time
1	Individual and grouped assignments a) Student competence to read and understanding the text books of physical chemistry. b) In addition, he/she also competence to solve problems and design experiment of physical chemistry.	
2	Students Presentations Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	
3	Discussions Lecturer ask the students to answer one or two questions to check their understanding about the concepts	

VI. Evaluation

- a. an ability to communicate concepts and principles in physical chemistry
- b. an ability to solve problems and exercises
- c. an ability to design the laboratory prototypes

LESSON PLAN

Department	: Chemistry
Subject Title	: Physical Chemistry I (Chem. 001)
Topic	: Kinetics Molecular of gases
Program	: 2008 ISTE Students
Lecture Time	: 3 X 50 minutes
Schedule	: Fourth week

I. Basic Competency

Student competence to understand some concepts dealing with kinetics particle in box, Boltzmann - Maxwell statistics and some application of Maxwell - Boltzmann statistics.

II. Indicator

Students are able to make a derivation of molecular kinetics of gas in container, Maxwell-Boltzmann statistics and classical mechanics, gas diffusion and using Graham's law in real times problems.

III. Topics/Sub-Topics

Kinetics Molecular of gases

1. Classical mechanics of Imaginary particle in a container
2. Kinetics particle in container equations, calculation of a particle velocity
3. Boltzmann distribution, and determination of Boltzmann constant
4. Maxwell-Boltzmann statistic mechanics and derivation
5. Mean free-path
6. Gas diffusion and Graham's law
7. Some applications
8. Barometric equations
9. Problem & Solution

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations
3. Discussions

V. Learning Process

Number	Activities	Time
1	Individual and grouped assignments a) Student competence to read and understanding the text books of physical chemistry. b) In addition, he/she also competence to solve problems and design experiment of physical chemistry.	
2	Students Presentations Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	
3	Discussions Lecturer ask the students to answer one or two questions to check their understanding about the concepts	

VI. Evaluation

- a. an ability to communicate concepts and principles in physical chemistry
- b. an ability to solve problems and exercises
- c. an ability to design the laboratory prototypes

LESSON PLAN

Department	: Chemistry
Subject Title	: Physical Chemistry I (Chem. 001)
Topic	: Chemical Thermodynamics
Program	: 2008 ISTE Students
Lecture Time	: 3 X 50 minutes
Schedule	: Fifth week

I. Basic Competency

Student competence to understand some concepts dealing with chemical thermodynamics, thermodynamics processes, works and using enthalpies.

II. Indicator

Students are able to use first, second and third law of thermodynamics, free energy and students have an ability to solve some concepts regarding thermodynamics problems.

III. Topics/Sub-Topics

Chemical Thermodynamics

1. Thermodynamic terms and basic concepts, variables of thermodynamics
2. Types of systems
3. Intensive and extensive properties
4. Thermodynamic process, reversible and irreversible processes
5. First law of thermodynamics
6. Isothermal expansion work; reversible and irreversible
7. Work efficiency and Carnot circles
8. Enthalpy of a system
9. Second law of thermodynamics
10. Spontaneous and non spontaneous reactions, free energy
11. Third law of thermodynamics
12. Problem & Solution

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations
3. Discussions

V. Learning Process

Number	Activities	Time
1	Individual and grouped assignments a) Student competence to read and understanding the text books of physical chemistry. b) In addition, he/she also competence to solve problems and design experiment of physical chemistry.	
2	Students Presentations Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	
3	Discussions Lecturer ask the students to answer one or two questions to check their understanding about the concepts	

VI. Evaluation

- a. an ability to communicate concepts and principles in physical chemistry
- b. an ability to solve problems and exercises
- c. an ability to design the laboratory prototypes

LESSON PLAN

Department	: Chemistry
Subject Title	: Physical Chemistry I (Chem. 001)
Topic	: Thermo Chemistry
Program	: 2008 ISTE Students
Lecture Time	: 3 X 50 minutes
Schedule	: sixth and seventh weeks

I. Basic Competency

Student competence to understand some concepts regarding thermo chemistry, the heat and enthalpies.

II. Indicator

Students are able to use thermo chemistry equations to real times problems, C_v , C_p , heats. Students are able to make a design of experiments based on calorimetric measurements.

III. Topics/Sub-Topics

Thermo chemistry

1. Changes in state at constant Volume and Temperature
2. The relation between C_p and C_v
3. Thermodynamics application to chemical reactions, the heat of reaction
4. The formation reaction
5. Conventional values of molar enthalpies
6. The determination of heats of formation
7. Sequences of reactions: Hess's law
8. Heats of solution and dilution
9. Heat of reaction at constant pressure and volume
10. Bond enthalpies
11. Calorimetric measurements

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations
3. Discussions

V. Learning Process

Number	Activities	Time
1	Individual and grouped assignments a) Student competence to read and understanding the text books of physical chemistry. b) In addition, he/she also competence to solve problems and design experiment of physical chemistry.	
2	Students Presentations Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	
3	Discussions Lecturer ask the students to answer one or two questions to check their understanding about the concepts	

VI. Evaluation

- a. an ability to communicate concepts and principles in physical chemistry
- b. an ability to solve problems and exercises
- c. an ability to design the laboratory prototypes

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LESSON PLAN

Department : Chemistry
Subject Title : Physical Chemistry I (Chem. 001)
Topic : Chemical Equilibrium
Program : 2008 ISTE Students
Lecture Time : 3 X 50 minutes
Schedule : Ninth week

I. Basic Competency

Student competence to understand some concepts dealing with chemical equilibrium, heterogeneous and homogeneous reaction.

II. Indicator

Students are able to use some equations in chemical equilibrium to real times problems.

III. Topics/Sub-Topics

Chemical Equilibrium

1. Definitions
2. Thermodynamics of equilibrium
3. K_p and K_c properties and calculations
4. Homogeneous reaction equilibrium
5. Equilibrium in gas states
6. Equilibrium in liquid states
7. Temperature dependence
8. Heterogeneous reaction equilibrium
9. The equilibrium constant for heterogeneous reactions
10. Effects of pressure/temperature on heterogeneous equilibrium
11. Distribution law
12. Problem & Solution

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations
3. Discussions

V. Learning Process

Number	Activities	Time
1	Individual and grouped assignments a) Student competence to read and understanding the text books of physical chemistry. b) In addition, he/she also competence to solve problems and design experiment of physical chemistry.	
2	Students Presentations Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	
3	Discussions Lecturer ask the students to answer one or two questions to check their understanding about the concepts	

VI. Evaluation

- a. an ability to communicate concepts and principles in physical chemistry
- b. an ability to solve problems and exercises
- c. an ability to design the laboratory prototypes

LESSON PLAN

Department	: Chemistry
Subject Title	: Physical Chemistry I (Chem. 001)
Topic	: Liquids
Program	: 2008 ISTE Students
Lecture Time	: 3 X 50 minutes
Schedule	: Tenth week

I. Basic Competency

Student competence to understand some concepts dealing with liquids, liquids dynamics and some physical properties of liquids.

II. Indicator

Students have some knowledge in liquids, liquids physical properties and having some knowledge in measurements of surface tension, viscosity, refractive index and optical activity.

III. Topics/Sub-Topics

Liquids

1. Critical Phenomena in liquids
2. P-V-T relations
3. Van der Waal relations on liquefaction of gases
4. Kinetic molecular description
5. Intermolecular forces in liquids
6. Vapor pressure
7. Measurements of vapor pressure
8. Surface tension of liquids
9. Measurements of surface tension
10. Viscosity of liquids
11. Measurements of viscosity
12. Refractive index
13. Measurements of refractive index
14. Optical activity
15. Measurements of optical activity
16. Problem & Solution

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations

3. Discussions

V. Learning Process

Number	Activities	Time
1	Individual and grouped assignments a) Student competence to read and understanding the text books of physical chemistry. b) In addition, he/she also competence to solve problems and design experiment of physical chemistry.	
2	Students Presentations Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	
3	Discussions Lecturer ask the students to answer one or two questions to check their understanding about the concepts	

VI. Evaluation

- a. an ability to communicate concepts and principles in physical chemistry
- b. an ability to solve problems and exercises
- c. an ability to design the laboratory prototypes

LESSON PLAN

Department	: Chemistry
Subject Title	: Physical Chemistry I (Chem. 001)
Topic	: Solutions
Program	: 2008 ISTE Students
Lecture Time	: 3 X 50 minutes
Schedule	: Twelfth and thirteenth weeks

I. Basic Competency

Student is able to describe the terms of solutions, ideal solutions and Raoult's law, miscibility of mixtures and distillation principles

II. Indicator

Student competence to understand some knowledge in solutions, solubility, and miscibility. Students are having some knowledge in liquids mixture, curvature of miscibility and principles of distillations and azeotropic mixtures. Students are able to explain the curvature and to make calculations.

III. Topics/Sub-Topics

Solutions

1. Definition
2. Factors affecting solubility
3. Kinds of Solutions
4. Ideal Solutions and Raoult's Law
5. Miscibility (Complete Binary and Ternary Mixtures)
6. Miscibility of partial solutions
7. Azeotropic Mixtures Distillations and principle of distillations
8. Colligatives properties
9. Lowering Vapor pressures by small addition of solute
10. Boiling point elevation of solutions
11. Calculation of molecular weights from boiling point elevation

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations
3. Discussions

V. Learning Process

Number	Activities	Time
1	Individual and grouped assignments a) Student competence to read and understanding the text books of physical chemistry. b) In addition, he/she also competence to solve problems and design experiment of physical chemistry.	
2	Students Presentations Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	
3	Discussions Lecturer ask the students to answer one or two questions to check their understanding about the concepts	

VI. Evaluation

- a. an ability to communicate concepts and principles in physical chemistry
- b. an ability to solve problems and exercises
- c. an ability to design the laboratory prototypes

LESSON PLAN

Department	: Chemistry
Subject Title	: Physical Chemistry I (Chem. 001)
Topic	: diffusion and osmosis
Program	: 2008 ISTE Students
Lecture Time	: 3 X 50 minutes
Schedule	: fourteenth week

I. Basic Competency

Student competence to understand some concepts and theoretical background of osmotic pressure.

II. Indicator

Students are able to make calculations of osmotic pressure. Students are able to describe membrane, determination of molecular weight from osmotic pressure.

III. Topics/Sub-Topics

Diffusion and osmosis

1. Osmosis and osmotic pressure
2. Vant Hoff's equation for osmotic pressure
3. Semi permeable membrane
4. Determination of osmotic pressure
5. Isotonic solutions
6. Determination of molecular weight from osmotic pressure
7. Relation between vapor pressure and osmotic pressure
8. Osmotic pressure of electrolytes
9. Problem & Solution

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations
3. Discussions

V. Learning Process

Number	Activities	Time
1	Individual and grouped assignments a) Student competence to read and understanding the text books of physical chemistry. b) In addition, he/she also competence to solve problems and design experiment of physical chemistry.	

2	Students Presentations Student competence to perform student's personal skills in presenting his/her assignments in front of classroom.	
3	Discussions Lecturer ask the students to answer one or two questions to check their understanding about the concepts	

VI. Evaluation

- a. an ability to communicate concepts and principles in physical chemistry
- b. an ability to solve problems and exercises
- c. an ability to design the laboratory prototypes

LESSON PLAN

Department	: Chemistry
Subject Title	: Physical Chemistry I (Chem. 001)
Topic	: Colloids and Surfaces Chemistry
Program	: 2008 ISTE Students
Lecture Time	: 3 X 50 minutes
Schedule	: Fifteenth and sixteenth weeks

I. Basic Competency

Student competence to understand some concepts about colloids dispersion, association colloids and the relation of colloids and surface phenomenon.

II. Indicator

Students are able to describe the colloids dispersion, colloidal systems, colloids properties, association colloids. Students are able to describe colloidal synthesis and able to design *problem solving in real times problems*.

III. Topics/Sub-Topics

1. Colloids and surfaces chemistry
2. Colloidal dispersions
3. Types of Colloidal Systems
4. Sols
5. Preparations of Sols
6. Properties of Sols
7. Association of Colloids
8. Micelle properties
9. Emulsion
10. Application of Colloids

IV. Learning Methods

1. Individual and grouped assignments
2. Students presentations
3. Discussions