Instructional Analysis (IA)
AND
ONE SEMESTER LEARNING PLAN (RPSS)

Thermodynamics (KIM 1241 2(2-0))

By:

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Instructional Analysis

Learning Outcomes :

Be able to understand process of physical/chemical transformation of the material, energy is the key factor and plays the most role in controlling of the transformation process.

Be able to understand the law of the conservation of energy, quantify the energy level of the process of changes in internal energy, enthalpy, entropy and free energy.

Be able to understand thermodynamics to predict, simulate material transformation trends through process variables

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4. Be able to explain the concept of combining Laws I and II of Thermodynamics

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3. Be able to explain the concept of an isolated system which includes the system and the environment, disorder and entropy formulating it in the Second Law of Thermodynamics

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2. Be able to explain the concepts of heat, work and energy, and formulate them in the Zero Law, and the First Law of Thermodynamics

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1. Be able to explain, calculate using the relationship parameters of pressure, temperature, volume, number of moles, and intermolecular interactions, in the formula of the equation of state of an ideal gas,

SYLLABUS

Course Name/Code	:	Thermodynamics /KIM 1241
Semester/Credit	:	Odd (Semester 3) / 2(2-0)
Description	:	This course discusses the laws of thermodynamics which can be used as a quantitative measure of the degree of tendency of material physical/chemical transformation processes. The level of spontaneity/non-spontaneity of material physical/chemical transformations can be measured using the magnitudes of internal energy, enthalpy, entropy and free energy. The advantage of the study of thermodynamics is its ability to predict a process to be studied by relating it to existing process data using interconnected standard state rules. The ability to apply thermodynamic concepts will greatly assist in supporting the success of synthesis (material transformation) and/or separation without having to use a trial and error approach. Simulation of changing process variables such as temperature and pressure in a direction that produces a thermodynamically spontaneous reaction, will help the success of research without having to carry out repeated experiments. To get to that stage requires a fundamental and comprehensive understanding of the laws of thermodynamics which is the topic of discussion in this course. The scope of the discussion and the learning process is to use active learning through small group discussions, cooperative learning, and assignments. The language of instruction used in this course is Indonesian.
Prerequisite Courses	:	**None**
Learning Outcome (LO)	:	1. Mampu memahami proses transformasi fisika/kimia terhadap material, energi merupakan faktor kunci dan paling berperan dalam mengontrol terjadinya peristiwa tersebut 2. Mampu memahami hukum kekekalan energi, kuantifikasi tingkat energi proses perubahan dalam bentuk energi dalam, entalpi, entropi dan energi bebas. 3. Mampu memahami termodinamika untuk memprediksi, mensimulasi kecenderungan transformasi material melalui variabel proses
Divisi/Bidang Ilmu	:	Kimia Fisik/Termodinamika
Dosen	:	1. Dr. Sri Mulijani, MS 2. Dr. Komar Sutriah, MS 3. Dr. Henny Purwaningsih, MS

Rencana Pembelajaran Satu Semester (RPSS) Kuliah:

WEEK	LEARNING OUTCOME	TOPIC	METHOD	INDICATOR	GRADE (%)
1	**2**	**3**	**4**	**5**	**6**
1 & 2	Able to explain, calculate using the relationship parameters of pressure, temperature, volume, number of moles, and intermolecular interactions, in the formula of the equation of state for ideal gases and real gases.	1. Understanding of temperature, pressure, number of moles and intermolecular forces. 2. Understanding of isothermal processes, isobars, isochores. 3. Intermolecular interactions and gas compressibility factors. 4. Virial equations and van der Waals equations.	Lectures, interactive discussions	Completeness and accuracy of explanations and calculations regarding temperature, pressure and intermolecular forces, isothermal processes, isobars, isochores, compressibility factors, virial and van der Waals equations.	
3, 4, 5,6,7	Able to explain the concepts of heat, work and energy, and formulate them in the Zero Law and First Law of Thermodynamics.	1. The concept of system and environment, energy as heat and work. 2. Reversible and irreversible processes, state function and path function, extensive and	Lectures, interactive discussion	Completeness and correctness of explanations and calculations regarding energy, heat and work in reversible and non-reversible states. Formulation of the First Law involving ΔU, ΔH and their measurements. Standard state energies, transitions, dissolving and	

		intensive properties. 3. The concept of ΔU, ΔH, and their formulation in the formulation of the First Law, and how to measure them by calorimetry. 4. Standard state enthalpies, phase transition enthalpies, dissolution enthalpies, lattice energies and hydration energies in the Born-Haber cycle. 5. The dependence of enthalpy on temperature, the Joule experiment, and the Joule-Thomson experiment, and the adiabatic change for the phenomenon of decreasing temperature		Born-Haber cycles. As well as the effect of temperature on enthalpy and adiabatic changes	
	Midterm Exam				**50**

8,9,10	Be able to explain the concept of an isolated system which includes the system and the environment, disorder and entropy formulating it in the Second Law of Thermodynamics	1. Entropy, entropy change (ΔS) and change in Gibbs free energy (ΔG) as criteria for spontaneity in the material transformation process 2. The Third Law and the entropy of a perfect crystal state at T=0K 3. Measurement of entropy in a transformation process, and the concept of efficiency of heat engines and Carnot cycles. 4. Calculate work to maintain low temperature and adiabatic demagnetization.	Lectures, interactive discussion	Completeness and correctness of explanations and calculations regarding the determination and calculation of entropy changes, Gibbs. Third law of thermodynamics and entropy in transformation processes, engine efficiency and Carnot cycles, adiabatic work	
11,12,13 ,14	Be able to explain the concept of combining the first and second laws of thermodynamics	1. Gibbs free energy change(ΔG) as a criterion for process spontaneity which focuses only on the system.	Lectures, interactive discussion	The completeness and correctness of explanations and calculations regarding Gibbs free energy (□G) as criteria for spontaneity, incorporation of laws I and II, derivation of the	

		2. 2. Combining Law I and II, deriving the thermodynamic equation of state 3. Chemical potential and fugacity for real gases. 4. Dependence of Gibbs free energy on temperature.		equation of state, chemical potential and functionality, and the effect of temperature on Gibbs free energy. Explaining the effect of temperature on reaction rates.	
	Final Exam				**50**

Assessment Plan:

Learning achievement	Lecture Exam	
	Midterm exam	**Final Exam**
1.Be able to understand the process of physical/chemical transformation of materials, energy is a key factor and plays the most role in controlling the occurrence of these events	√	√
2.Be able to understand the law of conservation of energy, quantification of energy levels the process of change in the form of internal energy, enthalpy, entropy and free energy	√	√
3. Be able to understand thermodynamics to predict, simulate tendency of material transformation through process variables	√	√

Grade Assessment:

Criteria Assessment	Grade	Grade in (%)	Remarks
Weekly Assignments Assessment Small group presentation: 1. Systematics and presentation content; 2. Timeliness of delivery; 3. Good use of language; 4. Ability to respond to questions (accurate or not); 5. Attitude in delivering the material (eye contact, posture, neat appearance) 6. Clarity of presentation (voice volume and intonation). Small group discussion and cooperative learning: 1. Communication Aspect: provide specific and easy-to-understand explanations; using methods/tools (gestures, analogies and concept maps) to help colleagues understand messages; Use a constructive way of expressing opinions and feelings. 2. Discussion aspect: not dominating the discussion and actively contributing. 3. Aspect of Openness: asking for feedback on himself and respecting the opinions of colleagues; using the knowledge and experience of other members in the group as a source of knowledge. 4. Other Behavioral Aspects: working together to develop group work plans and carry out evaluations; willing to accept special assignments/roles and share responsibilities.	55-100	50	Individual
Lecture Assessment: Midterm Exam Quis Final exam	 0-100 0-100 0-100	 20 10 20	 Individual Individual Individual
Grade Thermodynamics (KIM 1241 2(2-0))		**100**	

Criteria for assessing weekly assignments with instruments: group assessment forms and presentations

Rate Grade	Material Presentation Assessment Criteria
90-100	if students can present material with good systematics, timely delivery, good use of language, ability to answer questions properly/accurately, good and clear presentation of material.
80--<90	if students can present material with good systematics, timely delivery, good use of language, ability to answer questions properly/accurately
70--<80	if students can present material with good systematics, timely delivery, use of good language,

Refferences:

1. Atkins and Paula, 2010, Physcal Chemistry, 9^{th} Ed, Oxford University Press, USA.
2. P.W.Atkins, 1994, Kimia Fisika, Edisi Keempat, Erlangga, Jakarta.
3. Metz.C.R, 1989, Theory and Problems of Physical Chemsitry, 2^{rd} Ed, Schaum Series McGraw-Hill, USA.
4. Alberty, RA, 1992,Kimia Fisik Jilid I, Edisi kelima, Jakarta, Erlangga.