The Hebrew University of Jerusalem

Syllabus

PHYSICAL CHEMISTRY B - 69301

Last update 22-10-2017

HU Credits: 6

Degree/Cycle: 1st degree (Bachelor)

Responsible Department: chemistry

Academic year: 0

Semester: 1st Semester

Teaching Languages: Hebrew

Campus: E. Safra

Course/Module Coordinator: Prof. Uri Raviv

Coordinator Email: uri.raviv@mail.huji.ac.il

Coordinator Office Hours: Sundays, 9-10. It is recommended to come with question after setting an appointment

Teaching Staff:
Prof Uri Raviv
Mr. Roie Dann
Mr. shumilin ilan
Mr. ARNON EITAM

Course/Module description:
This is the second course in physical chemistry; it covers the field of thermodynamics.
The course reviews the basic terms (energy, heat, work, enthalpy, entropy, free energy, hear capacity, etc.) and the fundamental laws (I,II,III) of thermodynamics, with deep insights into the understanding of the forces which drive chemical reactions.

Course/Module aims:
See Learning Outcomes.

Learning outcomes - On successful completion of this module, students should be able to:
1. Understand the energetics that drive chemical reactions and physical changes

2. Analyze processes and reactions in thermodynamic terms (quantitatively).

3. Understand the relationship between macroscopic properties and the molecular make up of matter.

4. Give exact definitions for basic thermodynamic properties, e.g.: laws of thermodynamics, energy, heat, work, enthalpy, entropy, temperature, pressure, equilibrium constant, etc.

5. Solve practice questions in different complexity levels covering all the subjects of thermodynamics covered in the course.

Attendance requirements(%):
None

Teaching arrangement and method of instruction: Lecture and Exercise.

Course/Module Content:
Types of thermodynamical systems, thermodynamical variables, constraints.

Equilibrium. State functions and exact differentials.

The ideal gas equation of state. real gases and critical behavior. van der Waals equation. The virial theorem and intermolecular forces.

The first law of Thermodynamics: (internal) energy, heat and work. Calculations of work. Maximum work and reversible processes. Enthalpy. Thermochemistry. Heat capacity.

The second law of Thermodynamics: Number of states and entropy. Law of increasing entropy. Removal of internal constraints and thermal and mechanical equilibria. Statistical definitions of temperature and pressure. Heat engines. Entropy changes.

Free energies. Maxwell relations. Free energy by Gibbs and Helmholtz. Thermodynamic potentials. Spontaneity of processes and maximum work. The third law.

Phase transitions. The chemical potential, its physical meaning and dependence on temperature and pressure. Phase equilibrium. Clausius–Clapeyron relation. Phase diagrams and Gibbs' phase rule.

Chemical equilibrium: equilibrium in gas and ideal solutions. Equilibrium constant - dependence on temperature (van't Hoff equation).

Mixtures. Partial molar properties, Gibbs–Duhem equation. Ideal and non-ideal mixtures. Mixing entropy.

Ideal and non-ideal mixtures. Henry's and Raoult's laws. Colligative properties: boiling point, freezing point, osmotic pressure.

Required Reading:
The topics are covered in many basic physical chemistry books, such as those by: Castellan, Levine, Atkins, Moore, Silbey and Alberty
Specific references for these books will be given in the course.

Additional Reading Material:
K.A. Dill (Molecular Driving Forces)
Callen (Thermodynamics and Thermostatistics)
Reif (Fundamentals of Statistical and Thermal Physics)

Course/Module evaluation:
End of year written/oral examination 100 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 0 %
Assignments 0 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information:
The course is formal and not simple, and thus it is highly recommended to attend all classes (lectures and recitation classes).
The recitation classes will not repeat theoretical issues taught in the lectures, but will focus on problem solving. They will constitute the basis for solving the home assignments and the final exam.

Course website - Moodle. Please use the Q&A forum in the site.

Homework assignments:
תרגם

מומלץ מאד להגיש תרגילים אם כי אין חובה להגיש תרגילים. יהיו לפחות 12תרגילי בית. הציון על התרגיל יהיה בין 0 ל 1. כל תרגיל יוכל לתת עד חצי נקודת בונוס לציון המבחן הסופי (בהתאם לציון על התרגיל). בכל תרגיל מוגש ייבדקו כל השאלות או חלק מהשאלות שיבחרו באופן אקראי ותבוצע הערכה.

הערכה בקורס:
הציון של הבחינה המסכמת (+בונוס על התרגילים).
הבחינה תהיה עם דף נוסחאות ומחשבון בלבד.

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It is highly recommended to submit exercises, although there is no obligation to submit exercises. There will be at least 12 exercise sheets. The score on the exercise will be between 0 and 1. Each exercise will be able to give up to half a bonus point to the final grade, which will be determined by the final exam (depending on the score on the exercise). In each exercise, all the questions or some of the questions that will be chosen randomly will be examined and evaluated.

Course Evaluation:
The final grade will depend on the final exam (+ bonus on the exercises).
The exam will be with a formula sheet and a calculator only.