



**University of Miskolc**  
**Faculty of Materials Science and Engineering**  
**Antal Kerpely PhD School on Materials Science**  
**and Engineering**



# Bulk and Interfacial Equilibrium of Materials

George Kaptay, professor

**COURSE DESCRIPTION**

**SEPTEMBER, 2016**

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Dr. George Kaptay, professor, corresponding member of the Hungarian Academy of Sciences, Institute of Physical Metallurgy and Nanotechnology, Head of Department of Nanotechnology.

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## Target group of the course:

Suggested course, especially for students studying Interfacial Phenomena and Technologies.

## Language

English

## Goal of the course

To systematize the knowledge of the students gained during their BSc and MSc years on the subject and improve this knowledge to the PhD level, i.e. to the level of conducting independent research.

## Methodology of the course

Part 1: classroom presentations, using all possibilities of in-situ internet. Part 2: consultation with the students with the aim to show to them how they can use the knowledge of this course in their own research. It is suggested that each student participates in the consultations with all fellow students, as they can learn a lot from each other.

## Subjects covered

1. Bulk thermodynamics of materials – summary.
2. Interfacial thermodynamics of materials – summary
3. Modeling thermodynamic and thermophysical properties of materials.
4. Interfacial forces – summary.
5. Thermodynamics of nano-structured materials – summary.
6. Nano-phenomena – summary.
- 7 – 14. Consultations.

## References

J.W.Gibbs: On the Equilibrium of Heterogeneous Substances, Trans. Conn. Acad. Arts Sci. 1875-1878, vol.3, pp.108-248, pp.343-524

D.R.Gaskell: Introduction to thermodynamics of materials. 5th edition. Taylor and Francis, NY, 2008.

C.H.P.Lupis: Chemical Thermodynamics of Materials. Elsevier Sci Publ., 1983.

J.M.Israelachvili: Intermolecular and surface forces. Academic Press, London, 1998, 450 pp.

Lukas HL, Fries SG, Sundman B: Computational Thermodynamics. The Calphad method. Cambridge University Press, 2007, Cambridge, UK, 313 pp.

A.W.Adamson: Physical Chemistry of Surfaces, 5th ed., John Wiley and Sons Inc., NY, 1990.

N.Eustathopoulos, M.G.Nicholas, B.Drevet: Wettability at High Temperatures, Pergamon, 1999.

T.Iida, R.I.L.Guthrie: The Physical Properties of Liquid Metals, Clarendon Press, Oxford, 1993, 288 pp.

Papers by George Kaptay (see on Web of Science and on [www.kaptay.hu](http://www.kaptay.hu))

## Evaluation of students performance

Oral exam on the above list of subjects.

## List of questions for the complex exam

1. Basic equations of Calphad (bulk thermodynamics).
2. Interfacial energies: their nomenclature and modelling their temperature- and concentration dependence.
3. Basic equation for modelling thermodynamic and thermophysical properties.
4. Interfacial forces: basic equations, classification of interfacial forces and how they fit the newtonian mechanics
5. Basic equations of nano-Calphad (thermodynamics of nano-materials).