Final exam questions

Subject group name: **Heat transfer**

Neptun code: ZVEGEENBGHK

Credit points: 4

Subject(s) in this subject group:

- **Heat Transfer G** (BMEGEENBGHK)

Program: Mechanical Engineering, BSc (2NAAG0)

Specialization(s): Process engineering

Responsible person(s):

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You can check the current subject forms at the Educational Portal of the Faculty of Mechanical Engineering.

https://oktatas.gpk.bme.hu/

Always check the for updates at edu.gpk.bme.hu before preparing for the exam, especially if the subject group contains at least one subject from your final semester!

Valid from 27 February 2023

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assistant professor

I. Thermal radiation
   1. What are the important characteristics of thermal radiation and what is its physical background?
   2. What are the fundamental equations to model the phenomenon?
   3. Please, describe the interaction between the thermal radiation and an object. What are the basic body models?
   4. Please, define the mutual emissivity factor and how it can be derived with showing an example.

II. Laws of thermodynamics
   1. What is the I. law of thermodynamics considering a continuum model? What sort of source terms could appear here?
   2. What is the II. law of thermodynamics considering a continuum model? How the II. law affects the models of heat transfer?
   3. Please, explain how to use the II. law of thermodynamics to derive consitutive equations through the example of Fourier's law.

III. Thermal modeling of fins
   1. What are the simplifying assumptions?
   2. What are the typical boundary conditions used in thermal modeling of fins?
   3. What are the corresponding temperature distributions?
   4. What is the connection between the fin efficiency and its thermal resistance?

IV. Steady-state heat conduction
   1. What model can be used to model steady-state heat conduction?
   2. Please, describe how to solve the problems with and without heat sources?
   3. Please, describe the typical temperature distributions for slab, cylindrical and spherical geometries without heat sources.
   4. How the temperature-dependent thermal conductivity affects the thermal resistances? Please, present an example for temperature-dependent thermal resistance.

V. Transient heat conduction I.
   1. Please, describe the modeling possibilities.
   2. Please, describe the possible initial and boundary conditions.
   3. Please, describe the solution methods considering finite-size continuum objects? Please, present their background schematically.

VI. Transient heat conduction II.
   1. Please, present the modeling possibilities for infinite and semi-infinite objects.
   2. Please, present the possible initial and boundary conditions.
   3. Define the thermal effusivity and present its utilization in calculation of contact temperature.

VII. Heat exchanger equipments
   1. Present the fundamental principles of heat exchangers. What sort of heat transfer phenoma are expolited for heat exchangers?
   2. What are the simplifying assumptions?
   3. What are the typical temperature profiles for parallel flow, counter flow and cross-flow heat exchangers?
   4. Please, describe how to model the efficiency of a heat exchanger.
   5. What is the logarithmic mean temperature difference?

VIII. Measurement methods
   1. Please, present the measurement possibilities and their properties for thermal conductivity.
   2. What method can be used to measure the contact thermal resistance? What are the modeling aspects of contact thermal resistance?

3. Please, show an example for thermal diffusivity measurement. What are the essentail steps in the evaluation of the measured temperature history?

IX. Heat convection without phase change
1. Please, present the Newton's law of convection.
2. Please, describe what factors influence the heat transfer coefficient. What are the essential steps to determine the heat transfer coefficient?
3. What is the Nusselt equation? Please, present its role in the determination of the heat transfer coefficient.

X. Heat convection with phase change
1. Please, present the convection phenomenon when either boiling or condensation occurs.
2. What are the characteristics of such phenomena? What are the influental factors?
3. Please, present the boiling diagram and the characteristic regions. What measurement is used to record such diagram?
4. What is the relation between dry out and the phase change in multiphase flows for vertical flow situation?

XI. Numerical methods
1. What is the reason to use numerical methods?
2. What are the essential attributes of a numerical solution?
3. Please, present the schemes of explicit and implicit finite difference method on the example of Fourier heat equation. What is the main difference between these methods?