Wrocław, March 31, 2021.

RANGE OF DIPLOMA DISSERATTION
for main field of study
MECHANICAL ENGINEERING AND MACHINE BUILDING
2nd level of education
specialization: ***Refrigeration and Cryogenics***

1. Relation between temperature and energy. Unattainability of absolute zero and its consequences.
2. Entropy minimization method of the optimization of thermal processes and equipment.
3. Linde's refrigeration cycle. The basic parameters and their representation on lgp-h diagram. The comparison with the Carnot cycle.
4. The differences between the ideal and actual compressor refrigeration cycle. Interpretation on lgp-h diagram.
5. Sources of irreversibility of the Linde's compressor refrigeration cycle.
6. The energetic outcome of an industrial absorption refrigeration chiller working with NH3-H2O mixture. Its interpretation in the h-ξ diagram. The design processes.
7. Energy consumption and thermodynamic efficiency of cryogenic devices. Compression, work, heat, optimization of the process, significance for refrigeration and cryogenic cycles.
8. Trigeneration and its applicability. Possibilities of application of absorption machines in cogeneration and trigeneration systems.
9. Isentropic expansion, throttling, free exhaustion (exhaust), description (thermodynamic basics) and comparison of the processes.
10. Claude and Joule-Thomson liquefaction and refrigeration cycles, difference, depiction on T-s diagram (T-s diagram – process identification/presentation), energy balance, liquefaction and refrigeration capacity.
11. Cryocoolers – principles of operation, flow diagrams.
12. Methods of obtaining the temperatures below 1 K.
13. Thermodynamic principles of gas separation, Air rectification installation – flow scheme, single and double Linde column
14. Isentropic efficiency of the refrigeration compressors.
15. COP factor and the volume capacity for the compressor heat pump cycle and refrigeration cycle.
16. The possibilities of increasing of the COP of the compressor refrigeration cycles.
17. The refrigeration cycle with the economizer and its graphical interpretation on the lgp-h diagram.
18. The construction types of the heat exchangers used in cryogenic and refrigeration. Mathematical models and thermodynamic optimisation.
19. Insulation in refrigeration and cryogenic devices, superinsulation.
20. Materials used in cryogenic equipment. Lubrication of low temperature components in cryogenic devices.
21. Transfer lines and storage tanks for liquid gases – design principles.

22. Safety in handling of liquid gases, ODH
23. Types of refrigeration compressors and their basic parameters. Possibilities of motor overload protection.
24. Self-regulation of the compressor refrigeration plants. The most often problems and their representation in the lgp-h diagram.
25. Regulation of condensation pressure and evaporation pressure – main goal of the regulation and methods of its realization. Please present the principle and show the examples.
26. By-pass condensation pressure regulation.
27. Two stage refrigeration cycle and its graphical interpretation on the lgp-h diagram.
28. Variable refrigerant volume flow (VRV) direct system for air conditioning. Principle of operation, advantages and disadvantages.
29. Cryogenic systems for the superconducting devices
30. Natural and synthetic refrigerants and the basic rules of their application to the refrigeration plants.
31. Systems for heat recovery from compressor refrigeration plants.
32. Superconductivity – definition and physical explanation. Cryostating of superconducting magnets.
33. Technology of superfluid helium – application examples.
34. Safety regulations referred to the refrigeration plants.
35. Hot gas defrosting of unit coolers in the refrigeration plants.
36. Natural cooling methods. Present the application of natural methods of cooling. "Free-cooling" systems in refrigeration plants.
37. Explain the elements of heat balance for freezer room.
38. Capacity control of air and liquid cooled condensers.
39. Crystallization process in LiBr-H2O water chillers. Is it dangerous for the chiller? How to avoid this problem.