Course Description

Discipline/Course: "Designing and Calculating the Elements of the Equipment of the Industry".

The Basic Educational Program specialty: "Machines and Apparatus of Chemical Production".

Institute of High Technology Physics, Department of General Chemistry and Chemical Technology

Instructor: Vasiliy M. Belyaev, Assistant Professor

Contact details: +7 3822 701 777 1413, email: belyaev_vm@tpu.ru

Learning Outcomes:

The purpose of teaching the discipline "Design and calculation of the equipment elements of the industry" is the development of scientifically based methods and obtaining practical skills in calculating and constructing the most common elements of machines and devices for chemical production.

at the level of reproduction: master the terminology used in the design of the product.

at the level of understanding: goals and objectives of computer-aided design, the role and importance in the modern CAD design and manufacturing technologies.

Theoretical skills:

- General principles and methodology of designing machines and devices of the industry;
- Calculation and construction of thin-walled vessels;
- Calculation and construction of tightly-sealed connectors;
- Calculation and design of high-pressure apparatus;
- Calculation of fast rotating shells and disks;
- Calculation of equipment operating under conditions of dynamic oscillations;
- The influence of structural material and manufacturing technology on the design of machines and apparatus.

Practical skills:

To obtain practical skills in working with the regulatory documentation system when developing chemical equipment, assimilating the principles and content of the design stages, students carry out course work on an individual assignment.

Skills:

- The development of a general design drawing of a typical equipment,
- Schemes of loading of its elements,
- Selection of appropriate calculation methodology,
- The development of an algorithm and a computer program,
- Execution of calculations,
- Registration of results.

- Calculation and design of elements of machines and devices of the industry;
- Registration of design documentation.
- Correctly evaluate the nature of the loads acting on the element of the machine or apparatus, and correctly depict its design scheme;
- Reasonably choose the cheapest and available structural material, design load and allowable voltage;
- Carry out with the use of computers all the necessary structural and mechanical calculations of the elements of the equipment being developed, taking into account the requirements of normative and technical documentation.

Course Outline:

Section 1. General principles and methodology of designing machines and devices of the industry.

Section 2. Effect of the material of construction and manufacturing techniques for the construction of machines and apparatuses.

Section 3. Calculation and design of thin-walled vessels.

Section 4. Calculation and design of high-pressure apparatus.

Section 5. Calculation and design of tightly-robust plug connections.

Section 6. Calculation of fast rotating shells and disks.

Section 7. Calculation of equipment operating under conditions of dynamic oscillations.

Practice 1. Design and calculation of the strength of thin-walled shells.

Practice 2. Design and calculation of the strength and stability of thin-walled shells.

Practice 3. Design and calculation of the strength of flat lids and bottoms.

Practice 4. Design and calculation of hole reinforcements.

Practice 5. Designing and strength analysis of permanent connections.

Practice 6. Calculation and design of high-pressure apparatus.

Practice 7. Design and calculation of the strength of flanged connections.

Practice 8. Calculation of fast rotating shells and disks.

Practice 9. Calculation of shafts operating under dynamic oscillation conditions.

Lab 1. Calculation of the strength of shells loaded with internal pressure.

Lab 2. Calculation of the strength and stability of shells loaded with external pressure, axial compressive force, bending moment and shear force.

Lab 3. Coupling calculation of thin-walled shells.

Lab 4. Verification calculation of the strengthening of mutually influencing holes.

Lab 5. Calculation of the strength of strengthening holes.

Lab 6. Calculation of flange connections of devices.

Lab 7. Calculation of shafts for strength, rigidity and vibration resistance.

Lab 8. Calculation of the strength of the elements of the high-pressure apparatus.

Lab 9. Calculation of fast rotating disks by the sweep method.

Course Delivery: one semester, 18 weeks
Prerequisites: “Basics of computer-aided design”, “Strength of materials”, “Informatics”.
Co-requisites: “Theory of mechanisms and machines”, “Machine parts and design basics”, “Technology of chemical engineering”, “Materials Science”, “Metrology, standardization and certification”,
Final Assessment: pass/fail exam
Course Developer: Vasiliy M. Belyaev, Assistant Professor