CALCULATION AND DESIGN OF ROBOT MANIPULATORS

Department of Machines and Equipment Design

Faculty of Design and Engineering

Lecturer	**Spodoba Oleksandr**
Term	**2 semesters**
Major	**Bachelor degree**
ECTS credits	**10**
Control	**Exam**
Class-room hours	**300 hours (of them: lectures – 56 hours, practical or laboratory classes – 56 hours)**

Subject overview

The purpose of studying the discipline is to gain knowledge in an amount sufficient for independent solution of design and production-technological tasks in the field of construction, design and service maintenance of robotic systems and complexes intended for the automation of production (technological) processes of the agro-industrial complex. The acquired skills allow the use of engineering methods, analytical and numerical calculation methods for the analysis of known and development of new mechanisms, nodes and equipment complexes of robots and manipulators.

The task of the discipline is the formation of students' knowledge in the field of robotic systems and complexes and the ability to develop new designs of technological equipment, automatic machines, robotic systems and complexes, to perform work on technological support of agro-industrial and industrial production, modernization, operation of machines and equipment.

Lectures:

1. Introduction. Classification of robots and manipulators.
2. Construction of robots and manipulators.
3. Structural kinematic and technological parameters of robots and manipulators.
4. Principles of designing robots and manipulators.
5. The modular principle of designing robots and manipulators.
6. Technical documentation for calculating and designing robots and manipulators.
7. Materials for manufacturing structural elements of robots and manipulators.
8. The accuracy of the manufacturing of structural elements of robots and manipulators.
9. Mechanical system design. Orienting mechanisms.
10. Mechanical system design. Supporting system.
11. Executive system. Hydraulic drive.
12. Executive system. Pneumatic drive.
13. Executive system. Electric drive.
14. Design and calculation of handle mechanisms.

15. Calculation of transmission shafts.
16. Design and calculation of couplings.
17. Transmission mechanisms of the handle.
18. Design and calculation of gripping devices.
19. Calculation and design of connection of links.
20. Design and calculation of rotation mechanisms.
21. Worm mechanisms.
22. Planetary mechanisms.
23. Wave mechanisms.
24. Design and calculation of the support node of the rotation mechanism.
25. Design and calculation of elements of linear movement. Slip.
26. Design and calculation of elements of linear movement. Rolling.
27. Design and calculation of transmission mechanisms of linear movement. Ball screw and screw pairs.
28. Robotic and technical complexes.

Laboratory classes:

1. Compilation of the kinematic diagram of the robot and the manipulator.
2. Determination of the main structural components of robots and manipulators.
3. Calculation of the working area of robots and manipulators.
4. Setting tasks for designing robots and manipulators.
5. Study of modular elements of robots and manipulators.
6. Preparation of technical documentation.
7. Selection of materials for the construction of robots and manipulators.
8. Calculation of positioning error of robots and manipulators.
9. Calculation of moments and forces acting on orienting mechanisms.
10. Calculation of deformation of the supporting system.
11. Calculation of the hydraulic drive. Selection of components.
12. Calculation of the pneumatic drive. Selection of components.
13. Calculation of the electric drive. Selection of components.
14. Calculation of the stiffness of the handle.
15. Calculation of the transmission shaft.
16. Coupling selection. Calculation of the coupling angle.
17. Calculation of the transfer mechanism of the handle.
18. Calculation of the gripping mechanism.
19. Calculation of hinged connection of links.
20. Determination of forces on the output link of the rotation mechanism.
21. Calculation of the strength of the worm gear.
22. Calculation of planetary transmission.
23. Calculation of wave transmission.
24. Calculation and design of support mechanisms.
25. Selection and calculation of the stiffness of sliding guides.
26. Selection and calculation of stiffness of rolling guides.
27. Calculation of transmission screw nut.
28. Development of a robotic complex.

CHEMISTRY

Department of General, Organic and Physical Chemistry

Agrobiological Faculty
Speciality 133 Branch engineering

Lecturer	**Krotenko V.V.**
Term	**1**
Major	**Bachelor**
ECTS credits	**4**
Control	**Exam**
Class-room hours	**120 hours (of them: lectures – 30 hours, practical or laboratory classes – 30 hours)**

Subject overview

Chemistry is a fundamental discipline, which provides engineering students with a background in important concepts and principles of chemistry. Some of the most important objectives, though, are more “global” in nature. Emphasis will be placed on those areas considered most relevant in an engineering context, and practical applications in engineering and technology will be examined These goals deal with the overall relationship between chemistry (or science in general) and engineering rather than with the details of any particular chemical principle.

Overview of chemical engineering through discussion and engineering analysis of physical and chemical processes. Topics: overall staged separations, material and energy balances, concepts of rate processes, energy and mass transport, and kinetics of chemical reactions. Applications of these concepts to areas of current technological importance: biotechnology, energy, production of chemicals, materials processing, and purification.

Lectures:

1. The main concepts and laws of chemistry.
2. The atomic structure.
3. The periodic law and Mendeleev’s periodic table of chemical elements.
4. The chemical bond and the structure of molecules.
5. Thermodynamic laws of chemical transformations.
6. The chemical equilibrium and conditions of its shift.
7. The solutions of electrolytes.
8. The solution of non-electrolytes.
9. The redox processes and their conditions.
10. Bases of electrochemistry.
11. Electrolysis of melts and solutions of electrolytes as oxidation – reduction process.

12. Properties of non-metals and their compounds in materials and excipients engineering.

13. Chemistry of metals.

14. Bases of organic chemical compounds.

15. Polymeric materials and their applications in engineering.

Classes:

(practical, laboratory classes)

1. Introduction. Equipment and safety in chemical laboratory. Methods of chemical experiments.

2. Bases of modern nomenclature and classification of inorganic compounds.

3. The structure of the atom and Mendeleev's periodic law.

4. Determination of the types of chemical bonds between atoms in compounds. The relative electronegativity of atoms.

5. Determination of the thermal effect of the neutralization and dissolution of anhydrous salts.

6. Calculation of kinetic parameters of the reaction according to the experiment.

7. Determination of the conductivity of electrolyte solutions.

Indicator method of pH solutions calculation.

8. The preparation of solutions given concentration.

9. The properties of metals in redox reactions.

10 The dependence of electromotive force from galvanic cells of metals.

11. Investigation of electrolysis of aqueous solutions of electrolytes. The calculations of the aount of substances using Faraday's law.

12. Determination of corrosion mass index rate.

13. The chemical properties of metals and their compounds.

14. The genetic link between the classes of organic compounds, the methods of detection og organic compounds.

15. The properties of polymers. Introduction to methods of determining the quality of fuels.

DETAILS OF MACHINES, HOISTING AN CONVEYING MACHINERY

Department of Machines and Equipment Design

Faculty of Design and Engineering

Lecturer	**Romasevych Yuriy, Liashko Anastasia**
Term	**2 semesters**
Major	**Bachelor degree**
ECTS credits	**8**
Control	**Exam**
Class-room hours	**240 hours (of them: lectures – 75 hours, laboratory classes – 90 hours)**

Subject overview

The purpose of subject is the formation of students' systematic knowledge: using of structural materials, heat treatment, methods of calculation and design of general purpose parts, the application of modern methods of calculating passive gears, the choice of roller bearings, the assembly of kinematic schemes of actuators of agricultural machines, the use of the method of selecting the standard electric motors, reducers, mechanical couplings, the selection and use of conveying and hoisting machinery.

The objectives of the subject is as follows – to study the features of the calculation and design of general purpose components: gear gears and flexible couplings, shafts and axles, rolling bearings and sliding bearings, to master the specifics of the design of body parts and frames, to learn to independently design elements of agricultural machines (parts, assembly units), to calculate the capacity of conveying machinery, to calculate main mechanisms of hoisting machinery.

Lectures:

1. Introduction: What is Machine Design?
2. Transmission Mechanism. Gear.
3. Gear Failure.
4. Involute Spur Gears.
5. Calculation of spur gear.
6. Helical Spur Gear.
7. Bevel Gear.
8. Worm Gearing.
9. Chain transmissions.
10. Belt transmissions.
11. Shafts and axles.
12. Sliding and rolling bearings.

13. The combination of machine elements. Riveting couplings.
14. Combining elements with tension.
15. Slicing joints.
16. Seals, lubricants and devices.
17. Belt conveyors.
18. Bucket conveyors.
19. Chain Conveyors.
20. Screw Conveyors.
21. Overhead cranes.
22. Tower cranes and Derricks.
23. Ropes, Blocks-and Tackles.
24. LoadHandling Devices.
25. Hoists and Winches.

Laboratory classes:

1. Studying the design and determining the basic parameters of a cylindrical gearbox.
2. Adjustment of clutches of a closed worm gear.
3. Determination of the force of the previous tension of the flat pass.
4. Determination of the force of the previous tension of the wedge passive transmission.
5. Studying the design and determining the main parameters of the variator.
6. Study of design and research of speed variators.
7. Investigation of the resonance phenomenon of the rotating shaft.
8. Study of the design and determination of the main parameters of the bearings of sliding.
9. Determination of friction costs of bearings.
10. Research of work of bearing nodes.
11. Investigation of friction of bearing rollers.
12. Studying the elements of joints.
13. Research of safety couplings.
14. Investigation of springs “tension – compression”.
15. Determination of the volume of oil and lubrication conditions of gear units.
16. Belt Conveyor.
17. Screw Conveyor.
18. Bucket Conveyor.
19. Ropes, Block-And-Tackles.
20. Telpher.
21. Jacks.

ENGINEERING AND COMPUTER GRAPHICS

Department of descpriptive geometry, computer graphics and design

Faculty of Design and Engineering

Lecturer	**Nesvidomin Victor**
Term	**3 semesters**
Major	**Bachelor degree**
ECTS credits	**6**
Control	**Exam**
Class-room hours	**180 hours (of them: lectures – 30 hours, laboratory classes – 30 hours)**

Subject overview

Engineering and computer graphics are one of the educational disciplines that form the basis training of engineers, researchers, designers in mechanical engineering. The subject of the discipline is graphic constructions of spatial models, which are carried out with the help of drawing tools and computer technologies in accordance with existing standards. The goal of the discipline is for students to acquire theoretical knowledge of the basics of engineering graphics, acquiring practical skills in making technical drawings of parts and assemblies, mastery of modern graphic systems when creating 3D and 2D models. The main tasks of the discipline are: mastering the standards of execution of draftsmen; acquisition skills of displaying spatial products on a sheet of paper; drawing of dimensions and technical conditions for manufacturing the product; reading blueprints; creation of spatial models of products according to their drafters in various computer graphics systems; analysis of spatial models and execution of associative draftsmen.

Lectures:

1. Formats, scales, fonts.
2. Lines, dimensions, hatching.
3. Rectangular isometry.
4. Rectangular dimetri.
5. Frontal dimetri Technical drawing.
6. Cover up The shadows.
7. Complex cuts. Stepped cut.
8. Broken cut. Oblique section.

Laboratory classes:

1. Implementation title page independent album works.
2. Construction of different types of lines, sizes.
3. Building rectangular isometry details.
4. Building rectangular dimetry details.
5. Building technical drawing details in the front dimetry.
6. Building shading details in frontal dimetry.
7. Building step cut details.
8. Building broken section.

MATERIAL SCIENCE

Department of Material Technology and Material Science

Faculty of Design and Engineering

Lecturer	**Aftandiliants I., Prof.**
Term	**1 year**
Major	**Bachelor degree**
ECTS credits	**6**
Control	**Exam, Tests**
Class-room hours	**90 hours (of them: lectures – 45 hours, laboratory classes – 45 hours)**

Subject overview

The purpose and objectives of the course. Purpose is skills of Materials Science and laying the basis for the study subjects: "Machine parts", "Hoisting machinery", "Tractors and cars", "Agricultural and meliorative machines", "The safety and repair of machines." Objectives are study methods of obtaining metals and alloys and study of the structure, properties and destination of metals and alloys. Studying the basic theory of heat treatment of carbon and alloy steels, their technology heat and chemical-heat treatment, as well as specific details and working of agricultural machines. The study of the structure, properties and appointment of non-metallic construction materials. A result of studying of discipline the student should know the the main connections between the composition, structure and properties of metals and alloys, as well as patterns and changes in these properties under thermal, chemical or mechanical stress. A result of studying of discipline the student should be able to based on knowledge of the working conditions to work of the machine parts to select of the construction material for their production, type of hardening ore softening treatment for obtaining of the certain the properties of parts and billets.

Lectures:

1. The purpose and objectives of the course.
2. Phase transformations of metals and alloys.
3. Basic theory of alloys.
4. State diagrams of binary alloys.
5. Diagram of the iron – carbon alloys.
6. Carbon steels. Classification and application.
7. Cast irons, classification, application.
8. Theory of heat treatment.
9. The basic structure and transformation during heat treatment of steels.
10. Diagram of austenite isothermal disintegration.
11. The heat treatment technology of carbon steels.
12. Chemical heat treatment of steels.

13. Bases alloying steels.
14. Classification and labeling of alloy steels.
15. Constructional alloyed steels. Spring and ball bearing steels. Tool alloyed steels.
16. Steels and alloys with special properties.
17. Foreign labeling of alloy steels.
18. Copper, aluminum and their alloys.
19. Titanium, magnesium and their alloys. Bearing alloys.
20. Amorphous materials and materials with shape memory.
21. Composite and bimetallic materials.
22. Polymers and plastics.
23. Rubber.
24. Glue materials.
25. Inorganic glass.
26. Wood.
27. Paints.
28. Insulating materials.

Laboratory classes:

1. Macrostructural analysis of metals and alloys.
2. Microstructural analysis of metals and alloys.
3. The study diagrams of binary alloys.
4. The thermal method of analysis of metals and alloys. Construction of diagrams of tin-zinc alloys.
5. The analysis of state diagram of iron-carbon alloys.
6. Study of the microstructure of carbon steels at equilibrium state.
7. Study of microstructure of cast irons.
8. Structural changes in the carbon steel at heating.
9. Annealing and normalization of carbon steels. Study of microstructure and hardness changes.
10. Quenching of carbon steels.
11. Tempering of quenching steels.
12. Determination of critical temperatures of steels by method of test quenching's.
13. Determination of carbon steel microstructure in a no equilibrium state.
14. Surface hardening steels by high frequency currents.
15. Chemical heat treatment of steels.
16. Definition hardenability steels.
17. Study of microstructure of alloy steels.
18. Development of technological process of the heat treatment of parts of agricultural machines.
19. Study of the microstructure of copper alloys.
20. Study of the microstructure of aluminum alloys.
21. Study of babbit microstructure.
22. Composite and bimetallic materials.
23. Materials with shape memory.

MECHANICS OF MATERIALS AND CONSTRUCTIONS

Department of Mechanics

Faculty of Design and Engineering

Lecturer	**Anastasiia Kutsenko**
Term	**2**
Major	**Bachelor degree**
ECTS credits	**7**
Control	**Exam**
Class-room hours	**210 hours (of them: lectures – 75 hours, practical 45 and 45 laboratory classes hours)**

Subject overview

Purpose is skills of solving problems of Mechanics of materials and structures and laying the basis for the study subjects: "Load-lifting machines "**,** **"**Building machinery**",** **"**Machine elements**".**

Objectives:

- Study of the methods of calculation of structures for strength, rigidity and stability;

- Study of the stress-strain state of the beam at tension and compression, at direct shear, at torsion and at bending;

A result of studying of discipline the student should:

know:

- the basic hypotheses and methods, which are used of calculations for strength, rigidity and stability of elements of buildings;
- the methods of determining the internal forces factors in statically determinate and statically indeterminate elastic systems;
- the relation among external forces, stresses, and displacements in the different kind of simple and complex deformations.

Be able:

- to choose the optimal variants of calculation schemes of the elements of constructions;
- to combine calculations into one whole for the building;
- to choose the rational structural materials and the economic sizes of the cross section of the elements of construction.

Lectures:

1. Purpose and objectives of the course. The basic hypotheses and the definitions of the mechanics of materials and constructions.

2. The relation among internal forces and tensions in case of tension or compression of the bar.
3. The method of calculating the bar on strength.
4. The method of calculating the bar on rigidity.
5. The calculation of bar on strength with in terms of weight and temperature.
6. The calculation of statically indeterminate bars.
7. The geometric characterizations of the plane cross sections.
8. Analysis of Stress and Strain.
9. The direct shear stresses.
10. The definition of torsion.
11. The method of calculating the bar on strength and rigidity by torsion.
12. The equation of Shearing force for the cantilever and simple beams.
13. The equation of Bending moment for the cantilever and simple beams.
14. The calculation method cantilever beam on the strength by the normal stresses.
15. The calculation method simple beam on the strength by the normal stresses.
16. The definition of supports reaction of curveted beam.
17. The building of diagrams of internal efforts for a curveted beam.
18. The double integration method.
19. Verescagin´s rule.
20. Castigliano´s theorem.
21. The More's integral.
22. The construction method of the diagrams of shear-force and bending-moment for the cantilever frame.
23. The construction method of the diagrams of shear-force and bending-moment for the simple frame.
24. The definitions of the statically indeterminate constructions.
25. The application of the Castigliano´s theorem to the statically indeterminate constructions.
26. The three moment's theorem.
27. The application of the Verescagin´s rule to the statically indeterminate constructions.
28. Analysis of Stress and Strain in the case of combined bending and tension or compression.
29. Analysis of Stress and Strain in the case of a complex bending.
30. Analysis of Stress and Strain in the case of the off-centre acting of force of tension or compression.
31. Analysis of Stress and Strain in the case of combined bending and torsion at once.
32. The calculation method of column.
33. Analysis of Stress and Strain in the cases of acting difference types of dynamic loads.

Practical classes:

1. The construction of diagrams of normal force and normal stress for the bar.
2. The calculation of the bar on strength and rigidity.
3. The geometric characterizations of the plane cross sections.
4. The method of calculating the bar on strength and rigidity by torsion.
5. The construction of diagram of Shearing force for the cantilever and simple beams.
6. The construction of diagram of Bending moment for the cantilever and simple beams.
7. The calculation of beams on the strength by the normal stresses.
8. The calculation of beam strain by Verescagin´s rule and by the Castigliano´s theorem.
9. The construction of the diagrams of shear-force and bending-moment for the difference types of frame.
10. The curveted beam.
11. The calculation of the statically indeterminate constructions by difference methods.
12. The calculation of beam in the case of at one time action of bending and torsion.
13. The calculation of column.

Laboratory classes:

1. The determination of mechanical characteristics of "soft" steel in tension.
2. The experimental calculation of the modulus of elasticity for steel.
3. The experimental study of wood by compression.
4. The investigation of the stress state by strain gauge.
5. The experimental study of steel by compression.
6. The determination of the modulus of elasticity for plastics.
7. The experimental determination of Poisson's ratio for steel.
8. The study of the resistance of various structural materials on shear.
9. The study of the conceptions of building of diagrams of internal forces for beams by the mathematical modeling method.
10. The calculation statically indeterminate beams by the mathematical modeling method.
11. The study of the stress state of the frame by the mathematical modeling method.

MECHATRONIC SYSTEMS OF ROBOTS AND UAVS

Department of Machines and Equipment Design

Faculty of Design and Engineering

Lecturer	**Krushelnytskyi Viktor**
Term	**8 semesters**
Major	**Bachelor degree**
ECTS credits	**4**
Control	**Exam**
Class-room hours	**26 hours (of them: lectures – 13 hours, practical or laboratory classes – 13 hours)**

Subject overview

The purpose of studying the discipline "Mechatronic systems of robots and UAVs" within the framework of the specialty "Industrial mechanical engineering" is to provide students with theoretical knowledge and practical skills in the integration of mechanical, electronic and software components to create complex and functional mechatronic systems.

As a result of studying the discipline, students should know: AC electric drive classification, AC asynchronous motor operation principle, AC motor mechanical characteristics, frequency converter operation principle, PID controller operation principle, RS485 and RS232 interfaces, digital-to-analog converter operation principle, signal processing from UAV sensors.

Students should be able to: control a brushless DC motor by writing a control program for a microcontroller, calibrate quadcopter sensors, configure a frequency converter to control an induction motor, and configure a PID controller.

Lectures:

1. AC drive.
2. Mechatronic systems with a frequency-controlled drive.
3. PID regulator.
4. Signal processing from UAV sensors.

Laboratory classes:

1. Frequency-controlled drive
2. Digital-analog converter
3. Formation of a control signal using a DAC
4. External control of the frequency converter
5. PID regulator
6. Signal processing from UAV sensors

OPERATING SYSTEMS AND PROGRAMMING LANGUAGES FOR ROBOTS AND UAVS

Department of Machines and Equipment Design

Faculty of Design and Engineering

Lecturer	**Krushelnytskyi Viktor**
Term	**8 semesters**
Major	**Bachelor degree**
ECTS credits	**5**
Control	**Exam**
Class-room hours	**52 hours (of them: lectures – 13 hours, practical or laboratory classes – 39 hours)**

Subject overview

The purpose of the course "Operating Systems and Programming Languages for Work and BPLA" is to introduce students to the basic concepts, principles and tools used in the development and control of robots and unmanned aerial vehicles.

As a result of studying the discipline, students should know: operating systems and programming languages of robots and UAVs, what are the main tasks performed by the operating system of the robot, calculation systems in programming, the principle of operation of the segment indicator, the principle of operation of the liquid crystal display, how the operating system of the robot manages resources, planning processes in operating systems of robots.

Students should be able to: install the ROS operating system, implement FreeRTOS on a microcontroller, create functions and libraries in the C++ programming language, use object-oriented programming when writing programs, process data from sensors to make a robot decision.

Lectures:

1. Writing C++ programs.
2. Creation of functions and libraries.
3. Object-oriented programming.
4. Single board computers.
5. Operating systems and simulators for robotics.
6. Creating projects on ROS.

Laboratory classes:

1. Cycles and branching.
2. Conditional operator when working with ADC.
3. The selection operator.
4. Work with arrays.
5. Display of information on a liquid crystal display.
6. Creating functions.
7. Creation of libraries.
8. Creating a library for a segment indicator.
9. Object-oriented programming.
10. Installing the operating system on a single-board computer.
11. Simulator for robotics.
12. Controlling the movement of robots.
13. Processing data from sensors for robot decision-making.
14. Traffic trajectory planning and navigation.
15. Manipulator control.
16. Computer vision.
17. Data visualization in ROS.
18. Creation of ROS packages.

TECHNOLOGY OF CONSTRUCTION MATERIALS

Department of Material Technology and Material Science

Faculty of Design and Engineering

Lecturer	**Aftandiliants I., Prof.**
Term	**1 year**
Major	**Bachelor degree**
ECTS credits	**6**
Control	**Exam, Tests**
Class-room hours	**75 hours (of them: lectures – 45 hours, laboratory classes – 30 hours)**

Subject overview

The purpose and objectives of the course. Purpose is skills of Technology of construction materials and laying the basis for the study subjects: "Machine parts", "Hoisting machinery", "Tractors and cars", "Agricultural and meliorative machines", "The safety and repair of machines."Objectives are study methods of obtaining metals and alloys and study of the structure, properties and destination of metals and alloys. A result of studying of discipline the student should know the basis of technology of obtaining construction materials (metal alloys), the basic of recycling technological processes of metals and alloys in billet and finished products by casting, welding, processing by pressure, the main connections between the composition, structure and properties of metals and alloys, as well as patterns and changes in these properties under thermal, chemical or mechanical stress. A result of studying of discipline the student should be able to based on knowledge of the working conditions to work of the machine parts to select of the construction material for their production, type of hardening ore softening treatment for obtaining of the certain the properties of parts and billets.

Lectures:

1. Purpose and objectives of the course. The source materials in metallurgy and obtaining methods metals from ores.
2. Manufacture of the cast iron in the blast furnace.
3. Products of the blast furnace manufacture, their classification and using.
4. The source materials of the steel making.
5. The steel making. The technological processes of steel making in converters.
6. The technological processes of steel making in open hearth and electric furnaces.
7. Special methods of manufacture of high quality steels.
8. Secondary steel making.
9. Steel pouring.

10. Copper manufacture.
11. Aluminum manufacture.
12. Titanium-Magnesium metallurgy and its features.
13. Methods of powder receiving (mechanical, chemical). Preparation of powder charge.
14. Billet formation. Pressing, rolling, extrusion, slip casting. Sintering.
15. Classification, marking powders and their applications in engineering.
16. Technological scheme of manufacture castings. Casting production of in temporary mold. Gating system. Molding and core materials, their composition, properties and preparation. Pattern equipment.
17. Pouring, mold and core knock out, casting cleaning and cutting.
18. Special methods of casting manufacture.
19. Physical and technological bases of metal deformation. Temperature range of steel treatment by pressure. Heating furnaces and heating methods
20. Classification of treatment methods by pressure. The processes forging, drawing, pressing of steel billet. Hot and cold volumetric sheet stamping.
21. Theoretical basis of welding. Metallurgical and chemical-physical phenomena in the welding zone and their influence on the structure of ambient zone. The welding classification.
22. Electric arc and gas welding.
23. Special methods welding (electro slag, plasma, electron beam, mechanical friction, ultrasound, explosion, welding in protective gases and under water).

Laboratory classes:

1. Study of the source materials of the blast furnace manufacture.
2. Blast furnace products.
3. The source materials of the steel making.
4. The steel making products.
5. Rolled-formed sections.
6. The source materials and products of nonferrous metallurgy.
7. Determination of the properties of metallic powders.
8. Hardness determination of the steel and alloys.
9. Determination of properties of molded materials.
10. Designing of the technological process of casting manufacturing
11. Designing of the technological process of manufacturing steel forgings.
12. The influence of cold plastic deformation on properties and structure of steel.
13. Construction of the characteristics of the electrical welding transformer.
14. Determination of the regimes and technological coefficients at electric arc welding.
15. Welded seam defects and control methods.

TECHNOLOGY OF MACHINE BUILDING

Department of Material Technology and Material Science

Faculty of Design and Engineering

Lecturer	**Gnyloskurenko S., Ass.Prof.**
Term	**1.5 years**
Major	**Bachelor degree**
ECTS credits	**8**
Control	**Exam, Tests**
Class-room hours	**150 hours (of them: lectures – 75 hours, practical or laboratory classes – 75 hours)**

Subject overview

Technology of machine building (Mechanical engineering) is a discipline that give knowledge of regularities, rules in the processes of machines manufacturing, production with the purpose of their application to provide necessary machine quality, high efficiency and minimum self cost. This discipline requires an understanding of core areas including mechanics, dynamics, thermodynamics, materials science, design, structural analysis, and electricity. The objects are the technological methods of obtaining and processing billets, their technical and economic characteristics, the study of the basic schemes of equipment, issues of technological design of blanks, the methods of their obtaining, technological methods to improve the reliability of machines.The students will know the fundamentals of designing technological processes of mechanical processing of parts and be able to choose a rational way of mechanical processing of workpieces, selection of equipment, cutting tools, treatment regimes and the rational technology of manufacturing parts.

Lectures:

1. History of the developments, basics, fundamentals of machine building.
2. Fabricability (processability index, manufacturability of products design.
3. Fundamentals of locating parts, workpieces, products.
4. Accuracy of mechanical processing and methods of its providing.
5. Design of technological processes of mechanical processing.
6. Devices for metalworking machine tools.
7. Machining, processing parts of "Shaft" class.
8. Machining parts of "Shaft" class.
9. Machining parts of "Sleeves" class.
10. Machining parts of "Levers" class.
11. Machining parts of "Discs" class.
12. Machining parts of "Body parts" class.

Classes:

(practical, laboratory classes)

1. Study of the effect of elements of the cutting mode on the roughness of the machined surface during turning.
2. Methods of studying working hours. Timing of work on machines
3. The main stages of technological process design. Preliminary development of project solutions. Production type.
4. Selection of the type of workpiece. Basic requirements for blanks. Calculation of interoperational allowances for machining.
5. Technical control of parts of the "shaft" class.
6. Preliminary development of the technological route.
7. Technical control of body parts.
8. Preparation of technological documentation.