**Subject: BIOPHYSICS**

**Subject: VETERINARY MEDICINE**

**Laboratory classes – list of experiments and corresponding questions**

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| 1. **THERMODYNAMICS**
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| **Entropy/Enthalpy*** Thermodynamic system and thermodynamic parameters;
* State functions
* Heat, work and internal energy, units;
* Temperature as a measure of particles energy, scale of temperature;
* Specific heat;
* First law of thermodynamics;
* Thermodynamic processes
* Volume work and inner energy changes, enthalpy;
* Second law of thermodynamics;
* Entropy: thermodynamic and statistical definitions.
 | **Blood flow*** Thermodynamic system and thermodynamic parameters;
* Zeroth law of thermodynamics;
* Temperature as a measure of particles energy, scale of temperature;
* Heat, work and internal energy, units;
* Heat and heat transfer;
* Specific heat, heat capacity;
* Thermal expansion;
* First law of thermodynamics;
* Heat balances.
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| 1. **TRANSPORT PHENOMENA. MATTER, ENERGY AND MOMENTUM EXCHANGE**
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| **Viscosity*** Mass, weight and density
* Liquids and fluids;
* Pressure – methods of measurement and units;
* Buoyancy;
* Newtonian and non-Newtonian fluids;
* Continuity equation and Bernoulli’s principle;
* Laminar and turbulent flow;
* Viscosity, viscosity force (Newton’s law of hydrodynamics);
* Viscosity coefficient – properties and methods of measurement;
* Hagen-Poiseuille equation and Stocks law;
 | **Surface tension*** Weight, gravity and density of bodies; liquids and fluids - definitions;
* Kinetic and molecular theory of fluid structure;
* Surface tension factor;
* Detergents;
* Wetting and non-wetting liquids, contact angle;
* Surface phenomena: adhesion, cohesion, capillarity
* The phenomenon of formation and types of meniscus;
* Measuring the surface tension coefficient with a stalagmometer
 | **Ohm’s Law*** Current strength and voltage – definitions and units;
* Alternating and direct current;
* Current flow in electrical circuit;
* Resistance and conductivity;
* Ohm’s law;
* Electrical resistivity and conductivity;
* The dependence of resistance from geometrical parameters and temperature;
* Kirchhoff's circuit laws;
* Resistors series and parallel circuits.
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| 1. **OSCILATIONS AND MECHANICAL WAVES. BIOMECHANICS**
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| **Mathematical Pendulum*** Oscillations and simple harmonic motion basic concepts;
* Harmonic motion equation;
* Declination, velocity and acceleration in harmonic motion;
* Newton's law of universal gravitation;
* Mathematical pendulum;
* Frequency, period and oscillations’ amplitude
* Gravitational acceleration measurements with mathematical pendulum application.
 | **Spring Pendulum*** Oscillations and simple harmonic motion basic concepts;
* Harmonic motion equation;
* Declination, velocity and acceleration in harmonic motion;
* Frequency, period and oscillations’ amplitude
* Mass and weight;
* Mass on a spring movement;
* Hook’s law
* Isochronous oscillations
 | **Torque*** An idea of rigid body; types of motion;
* Torque (moment of force) and angular momentum;
* Angular momentum conservation;
* Moment of inertia (angular mass), Steiner theorem (Huygens-Steiner, parallel axis theorem);
* Dynamic’s laws for circular motion;
* Kinetic energy of circular motion;
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| **Ultrasounds*** Mechanical waves and mechanical wave equation;
* Basic concepts of wave movement: amplitude, period and frequency, wavelength etc
* Velocity of mechanical waves and its dependency from medium elasticity;
* Hook’s law and Young’s modulus;
* Acoustic waves and ultrasounds;
* Methods of obtaining ultrasounds.
* Sound intensity and sound intensity level;
* Acoustic impedance;
* Doppler effect and its application in blood flow measurements;
 | **Lever*** Statics and static equilibrium
* Centre of the mass (gravity)
* Equilibrium equation;
* Stability and balance;
* Leavers and mechanical advantage
* Examples of biomechanical levers
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| 1. **ELECTROMAGNETIC WAVES**
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| **Microscope/Lenses*** Reflection and refraction, Snell’s law
* Refractive indexes;
* Total internal reflection and critical angle;
* Lenses types;
* Focal point and focal length;
* Image construction in converging and diverging lenses
* Lens-maker’s equation and simplified lens equation;
* Optical power, units
* Dispersion;
* Microscope and magnifying glass (single microscope);
 | **Spectrophotometer*** EM radiation and EM spectrum (Vis, UV)
* Forms of inner energy of particles
* Spectrophotometer – construction and principle of operation
* Beer–Lambert law and its validity
* Absorbance, attenuation coefficient, absorbance additivity, transmittance
* Jablonski diagram
* Energy units in spectroscopy
* Emission and absorption spectrums
 | **Polarimeter*** EM radiation as a wave and particle - wave–particle duality
* EM spectrum.
* Polarization and features of polarized light
* Types of polarization
* Methods of polarization (reflection on dielectric, multiply refraction in dielectric, birefringence, dichroism, Nicol prism)
* Rotation of the plane of polarization by optically active substances
* Polarimeter – construction and principle of operation
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| 1. **NUCLEAR PHYSICS AND RADIOACTIVE DECAY**
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| **Radioactive decay*** Atom structure;
* α, β and γ decays
* Exponential decay;
* Exponential decay constant and half-life;
* Radioactive decay rates;
* Dosimetry and radiation protection;
* Nuclear reactions
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