SLOVAK UNIVERSITY of TECHNOLOGY IN BRATISLAVA
FACULTY OF MECHANICAL ENGINEERING
INSTITUT OF APPLIED MECHANICS AND MECHATRONICS

B.Sc. SYLLABUS

ENGINEERING MECHANICS I
STATICS

Number of subject: 2-5510
Study discipline: all study program (Number of credit 5) **Year:** first/summer
Lectures: 26 hour (2 hour/week) (13 week term) **Seminars:** 26 hour (2 hour/week)
Warrantor of subject: Assoc. Prof. M.Sc. PhD Stanislav Žiaran
Lecturer: Assoc. Prof. M.Sc. PhD Stanislav Žiaran 2008

Key words: vector, force, equilibrium, rigid body, constrain, centre of gravity, friction, locking, journal, rolling, virtual, stability, motion.

1. **Engineering mechanics**: Basic concepts, Axioms, Newton's laws, History of mechanics, Units and dimension, Problem solving and accuracy of solution; Methods a procedures of the solving of problems, Application of vector calculus, Forces and lines of action, rectangular components; Moments – moment of a force about a point, a line, the couple, Varignon´s theorem;
2. **Force systems**: Equipollence and equilibrium of force systems and its replacing in points, effects, Resultants, Invariants of force systems, Central axis of a force system, Force screw, General space force system, Parallel space force system, General plane force system, Parallel plane force system, Concurrent space force system, Concurrent plane force system, Distributed force system, Using of matrix calculus, Equations of equilibrium;
3. **Equilibrium of a particle**: Degrees of freedom, Statical determinacy, Constraints, Problems involving the equilibrium of a particle, Free-body diagram, Equilibrium of a particle in plane and in space, Solving of the equilibrium condition of the particle;
4. **Equilibrium of a body:** Degrees of freedom, Statical determinacy, *Equilibrium in two dimensions*: Mechanical system isolation – free-body diagram, Modelling the action of forces in two-dimensional analysis (constraints), Sample free-body diagrams, Equilibrium conditions, *Equilibrium in three dimensions:* Mechanical system isolation – free-body diagram, Modelling the action of forces in three-dimensional analysis (constraints), Equilibrium conditions, Applications, Cullman´s methods
5. **Centre of gravity, mass centre, centroid**: Distributed force systems, Centroid of fixed parallel force system, Centroids of lines, areas and volumes. First moment. Centre of gravity and mass centre of particles and rigid body, Theorems of Pappus-Guldinus, Experimental specifying of centre of gravity. Different between centre of gravity and mass centre. Composite plates and bodies.
6. **Structures – frames, machines and trusses:** Static analysis of system of bodies (frames, machines), Degrees of freedom, Static determinacy, *Equilibrium in two dimensions*: Mechanical system isolation – free-body diagram, Equilibrium conditions, Static analysis of the trusses, Plane trusses: Method of joints – successive and general, Method of section, Space trusses, Vector´s solution;

7. **Internal effects and cables:** Internal forces in members, Tension (compression), shear, bending and torsion, Relations between shear and bending (Schwedler-Zuravsky´s theorem), Diagrams. Flexible cables, Cables with concentrated and distributed loads. Parabolic cable, Catenary cable;
8. **Friction:** Introduction, The laws of dry friction, Coefficients of friction (static and dynamic), Angles of friction, Dry friction on one plane (one support), Locking, self-locking – dry friction on two plane (supports), Square-Threaded screws
9. **Friction and passive resistance:** Journal bearings – axial friction, Thrust bearings – disk friction, Wheel friction – rolling resistance, Belt friction, Rigidity of fibres, Real machines – structures with consideration of the passive resistance, Wedges and their application in practice, Static analyses of the system with two axles (one of them is driving)
10. **Analytical statics, kinematics:** Mechanical work of a force, Work of a couple, Work of a force during a finite displacement, Mechanical power, Mechanical efficiency, Principle of virtual work – Lagrange´s principle. Applications of the principle of virtual work, Potential energy, Potential energy and equilibrium, Stability of equilibrium, Introduction to the kinematics;
11. **Kinematics of Particles:** Rectilinear motion of particles, Determination of the motion of a particle, Uniform rectilinear motion, Uniformly Accelerated rectilinear motion, Relative motion of two particles, Curvilinear motion of particles. Rectangular co-ordinates. Normal and tangential components. Space curvilinear motion. Relative motion. Constrained motion of connected particles.
12. **Kinematics of Rigid Bodies:** Translation, Rotation about fixed axis, Equation defining the rotation of a rigid body about fixed axis, General plane motion, Absolute and relative velocity in plane motion, Instantaneous centre of zero velocity
13. **Kinematics of Rigid Bodies:** Absolute and relative acceleration, Analysis of plane motion in terms of parameters, Rate of change of a vector with respect to a rotating frame – Coriolis acceleration, Motion about a fixed point, General motion. Three dimensional motion of a particle relative to a rotating frame – Coriolis acceleration, Frame of reference in general motion

Literature:

McGill, D.J.-King, W.W.: Engineering mechanics – STATICS, DYNAMICS Boston 1989, Beer, F.P.-Johnston, E.R.: Vector mechanics for engineers STATICS, DYNAMICS New York 1988, Meriam, J.L.-Kraige, L.G.: Engineering mechanics STATICS, DYNAMICS New York 1992, Žiaran, S.: Technická mechanika – Statika. Vyd. STU Bratislava 2003