Biomechanics  
*Biomechanika*  
**Prof. Ing. Jiří Křen, CSc.**  

**Computational Methods of Dynamics**  
*Výpočtové metody dynamiky*  
**Prof. Dr. Ing. Jan Dupal**  
Computational Methods of Mechanics of Continuum  
**Výpočtové metody mechaniky kontinua**  
**Prof. Ing. Vladislav Laš, CSc.**


Damage and Failure of Composite Materials  
**Porušování kompozitních materiálů**  
**Prof. Ing. Vladislav Laš, CSc.**


Damage and Fracture of Structural Elements  
**Poškození a porušení konstrukčních prvků**  
**Doc. Ing. Petr Brož, DrSc.**

Background to continuum damage mechanics, numerical analysis of damage, damage localisation, damage models – the uniaxial and the one applicable to multiaxial state of stress, analysis of the crack root vicinity, criteria for crack propagation, linear elastic and elastic-plastic fracture mechanics, dynamic and time-dependent fracture, fracture mechanics in metals and nonmetals, fracture toughness testing of metals, fracture testing of nonmetals, computational fracture mechanics, determination of $K, J$, compliance and limit load solutions, ductile failures; creep, creep – fatigue and dynamic failure; failure of brittle and quasi-brittle materials.

Design and Monitoring of Composite Structures  
**Návrh a monitorování kompozitních konstrukcí**  
**Ing. Robert Zemčík, Ph.D.**


Dynamic Synthesis and Optimisation  
**Dynamická syntéza a optimalizace**  
**Doc. RNDr. Zdeněk Hlaváč, CSc.**

Classification of selected problems of dynamic synthesis of vibrating mechanical systems (condensation, tuning, optimisation). Methods of dynamic condensation.

**Dynamics of Machines**  
*Dynamika strojů*

**Prof. Ing. Vladimír Zeman, DrSc.**


**Experimental Dynamics and Identification**  
*Experimentální dynamika a identifikace*

**Prof. Ing. Miroslav Balda, DrSc.**


**Experimental Stress and Strain Analysis**  
*Experimentální pružnost*

**Prof. Ing. František Plánička, CSc.**


**Fracture Mechanics**  
*Lomová mechanika*

**Prof. Ing. František Plánička, CSc.**


**Fundamentals of Anatomy and Physiology**  
*Základy anatomie a fyziologie*

**Doc. MUDr. Jiří Motáň, CSc.**


**Fundamentals of Mechanics of Continuum**  
*Základy mechaniky kontinua*  
Prof. Ing. Josef Rosenberg, DrSc.


**Impact biomechanics**  
*Impaktní biomechanika*  
Doc. Ing. Luděk Hynčík, Ph.D.


**Interaction of Continua of Different Phases**  
*Interakce kontinuí různých fází*  
Prof. Ing. Jiří Křen, CSc.

Classification of continuum interaction problems (weak and strong coupled systems) and basic formulation of the problem of fluid-flexible body interaction. Lagrange’s and Euler’s description of interacting continuum characteristics, linear and non-linear problems of continuum interaction. Conjugated and non-conjugated methods of interaction problems solution, basic mathematical models. Laws of conservation in ALE description and application of ALE description to continuum interaction problems. Numerical methods for the solution of linear problems of continuum interaction.

**Interaction of Structures and Loading Effects of Ambience**  
*Interakce konstrukcí a zatěžovacích účinků okolního prostředí*  
Doc. Ing. Jan Pašek, Ph.D.

Effects of non-forced loads on structures – temperature fields, temperature shocks, moisture fields, rheological processes, chemical and physical degradation, movements of underlying bedrock. Effects of exceptional loads on structures – explosion, fire, vehicle / aircraft crash, technical and natural seismicity. Deformation
effects of structures, forced deformations. Single-layer and layered (sandwich) structures. Effect of stiffness of the structure loaded by non-force and extraordinary effects on its stress state. Effect of material parameters on the stress of the structures and their reliability – material strength, modulus of material elasticity, coefficient of thermal linear expansion of the material. Defects, failures and optimisation of structures due to loading effects of the ambience. Computer modelling and numerical simulations of static behaviour of the structures, stressed by loading effects of the ambience.

Kinematic Geometry

Doc. Ing. Jaromír Švígler, CSc.

Fundamentals of differential geometry of curves and surfaces. First and second basic tensors and surface curvature tensor. Trochoid and envelope surfaces. Important surfaces and their use in gear sets. Generation of conjugated surfaces which create a higher kinematic pair in the plane and in the space. Screw surfaces as a special case of general surfaces, their particular properties and application. Utilisation of trochoid and envelope screw surfaces for screw machines, their theoretical and real contacts.

Mathematical Modelling of Fluid Flow

Doc. Ing. Jan Vimmr, Ph.D.

Finite volume formulations of modern numerical schemes for numerical solution to inviscid and viscous laminar flow problems of compressible Newtonian fluid. Basic characteristics of turbulent flow, numerical solution to the system of Favre-averaged Navier-Stokes equations including an appropriate turbulence model. Application to problems of internal and external aerodynamics. Mathematical modelling of incompressible viscous fluids flow. Application in biomechanics, e.g. modelling of cardiovascular problems.

Mechanics of Heterogeneous and Multiphasic Continua

Prof. Dr. Ing. Eduard Rohan, DSc.

The course is intended as an introduction to the continuum description of heterogeneous materials consisting of interpenetrated solid and fluid phases. Continuum models of such media are indispensable for solving engineering problems in acoustics, tissue biomechanics, civil engineering, and environmental multiphysics. Main topics: basics of the phenomenological theory of porous multiphase media, volume fractions, chemical potentials and effective stresses, development of balance equations and constitutive laws; methods based on representing the microstructural volume elements, averaging methods, homogenisation method and two-scale modelling. Methodology of numerical modelling for multiscale computations.

Multibody Analysis, Synthesis and Optimisation

Prof. Ing. Jiří Křen, CSc.

Matrix methods for the solution of kinematic relations of multibody mechanical systems. Lower and higher kinematic pair transformation matrices. Numerical kinematic analysis of mechanisms. Kinematic analysis of mechanisms with higher

**Modelling and Description of Microscopic Structures for Purposes of Biomechanics and Nanomechanics**

*Modelování a popis mikrostruktur pro biomechaniku a nanomechaniku*

**Doc. Dr. RNDr. Miroslav Holeček**

Fundamentals of the microcontinual description for the generation of generalised continuum theories, basic principles of statistical description of microstructures and general conditions of transition to macroscopic continuum description (averaging). Illustrative examples of general thermodynamic connections from biomechanics (modelling of living tissues starting with the microscopic level) and nanomechanics (the Cauchy-Born rule).

**Multibody Mechanical Systems**

*Vázané mechanické systémy*

**Prof. Ing. Jiří Křen, CSc.**

Basic motion transformation matrix, point and body velocity and acceleration. Matrix formulation of simultaneous body motion. Structure and typology of multibody mechanical systems (MMS), structure description, vector and matrix methods of kinematic relations solution. Spatial MMS with lower and higher kinematic pairs. Numerical solution of MMS kinematic relations. Bivector, recursive method and mixed mode Lagrange´s equations application in matrix methods for MMS dynamic analysis, numerical solution of motion equations. MMS dynamic analysis considering body compliances and kinematic pairs, kinematically driven systems.

**Nonlinear Dynamic Systems and Chaos**

*Nelineární dynamické systémy a chaos*

**Prof. Ing. Josef Rosenberg, DrSc.**

Nonlinear oscillators, introduction to the theory of dynamic systems, point attractors and limit cycles in autonomous systems, bifurcations, Floquet theory, method of multiple scales, quasiperiodic solutions, periodic and chaotic attractors of excited oscillators, stability and bifurcations of iterative mapping, deterministic chaos in discrete dynamic systems, types of transitions to chaos, chaos in the Hamiltonian system, applications.

**Non-linear Mechanics of Continuum**

*Nelineární mechanika kontinua*

**Prof. Ing. Jiří Křen, CSc.**

Selected Chapters of Elasticity and Plasticity
Vybrané statě z pružnosti a plasticity
Prof. Ing. František Plánička, CSc.

Statistical Mechanics
Statistická mechanika
Prof. Dr. Ing. Jan Dupal

Structural Optimisation
Optimalizace konstrukcí
Prof. Dr. Ing. Eduard Rohan, DSc.

Theory of Gearing
Teorie ozubených převodů
Doc. Ing. Jaromír Švígler, CSc.
Gear sets as mechanisms with higher kinematic pairs, contact of tooth surfaces, constant ratio condition, relative motion axoides, generation of conjugated surfaces, point and curve contacts of conjugated surfaces. Transient surface. Gearing sensitivity to bearing deformations. Kinematics of machines producing gearings. General theory application to the theory of spur gearing, angle drive, worn gear and hypoid gear. Interference of conjugated surfaces.

Theory of Vibration
Teorie kmitání
Prof. Ing. Vladimír Zeman, DrSc.
Mathematical models of discrete non-conservative linear systems, classification, spectral and modal properties. Modal methods for dynamic response investigation of