



Taras Shevchenko National
University of Kyiv

Physics Department

Course description

Vector and Tensor Calculus

Level:	Language:	Duration:	Occurrence:
Bachelor	Ukrainian	1 semester	3 rd semester
Credits:	Total Hours:	Contact Hours	Self-study Hours:
3	90	45	45

Description of Course Work and Examinations

Module-rating system, results are evaluated on a 100-point scale. The course contains 3 midterms 90 min each that scale 40 pts altogether, and a final exam 60 pts/180 min.

Prerequisites

Analytic Geometry and Linear Algebra (1st – 2nd semesters)

Syllabus

Vector Algebra: scalar and cross products, mixed product, double cross product, collinearity, orthogonality and coplanarity, absolute value (length) of a vector, coordinate systems, basis, coordinates of a vector in a given basis, coordinate transformation, transformation matrix, orthonormal bases and orthogonal matrices, common transformation matrices (rotation, reflection, projection), Kronecker delta notation, Euler angles, transformation of vectors and tensors under coordinate transformations, co- and contravariant indices.

Tensor Algebra: arithmetic operations on tensors, inner and outer products, tensor contraction, symmetry properties, tensor symmetrization, practical applications (tensors of inertia, strain, stress), principal axes, eigenvalues and eigenvectors, invariants, characteristic equation for eigenvalues, Levi-Civita tensor and its usage in proving identities.

Vector Calculus: common differential operators (gradient, divergence, curl, Laplacian, material derivative), d'Alembertian, curvilinear coordinates, local basis, coordinate lines and surfaces, Jacobian matrix, Lamé coefficients, differential operations in curvilinear coordinates, curvilinear and surface integrals, divergence (Gauss) theorem, curl (Stokes) theorem.

Literature

1. M.F. Ledney, M.A. Razumova, O.V. Romanenko, V.M. Khotyaintsev. *Collection of problems on the vector and tensor calculus*. 2010 Kyiv, 129 p, ISBN 978-966-439-320-8.

Instructors

Professor Mykhailo F. Ledney/Associate Professor Svetlana P. Belykh.