UNIVERSITY OF NIŠ

Course Unit Descriptor	Faculty	Faculty of Mechanical Engineering

GENERAL INFORMATION	
Study Program	Mechanical Engineering
Study Module (if applicable)	-
Course Title	SELECTED TOPICS IN ADVANCED MATHEMATICS
Level of Study	☐Bachelor ☐ Master's ☒ Doctoral
Type of Course	☒ Obligatory ☐ Elective
Semester	☒ Autumn ☐ Spring
Year of Study	I
Number of ECTS Allocated	10
Name of Lecturer/Lecturers	Petković D. Ljiljana, Rajković M. Predrag, Mitrović S. Melanija, Radović M. Ljiljana, Živković S. Dragan
Teaching Mode	☒ Lectures ☐ Group tutorials ☐ Individual tutorials ☐ Laboratory work ☐ Project work ☒ Seminar ☐ Distance learning ☐ Blended learning ☐ Other

Purpose and Overview (max. 5 sentences)

Improving the knowledge in specific areas of mathematics (choose two areas of the six proposed) needed to further scientific student's research. Raising the general educational level, and the further development of the systematic work of students. Solving real problems using scientific methods and mathematical procedures, mastering methods and techniques of research and application of knowledge in practice, in order to successfully overcome the PhD curriculum and scientific research.

Syllabus (brief outline and summary of topics, max. 10 sentences)

Partial differential equations: Definition and classification of partial differential equations (PDE). The formation of PDE. Types of integral PDE. Euler's method of integration. Homogeneous and inhomogeneous linear PDE. Cauchy-s task (problem) for homogeneous and inhomogeneous linear equation. Geometric interpretation of equations. Equations with total differential. Pfaff's equation. Charpit Lagrange's method. Classification of second order PDE. PDE reducible to: ordinary differential equations correct statement; PDE of the first order; integrable form. PDE of hyperbolic, parabolic and elliptic type. Fourier method for the integration of wire that vibrates in the plane and spread the heat equations. Laplace's equation in plane and space.

Special functions: Hypergeometric function (HF). Classification and special cases. Recurrence and differential properties. Functions defined by integrals (gamma, beta end error function). Bessel functions. Elliptic functions. Orthogonal polynomials and HF. Integral transforms. Laplace and Fourier transform. Mellin and Hankel transform. Z-transform. Basic hypergeometric functions. Finite and infinite products. Basic derivative and basic integral. Special numbers and polynomials. Asymptotic expansions. Fractional calculus. Fractional integral and Riemann-Liouville derivative. Caputo derivative. Fractional equations.

Probability and Statistics: Introduction. Basic elements of set theory. Functions. Operations and algebraic structures. Basic concepts of combinatorics. Euler's integrals. Basic probability concepts. Probability space. Probability of events. Probability distribution. Random variable. Distribution function. Discrete and continues random variable. Basic elements of statistics. Population, sample – random sample, statistics. Parameter estimations, confidence intervals. Testing statistical hypothesis, parameter hypotheses, nonparametric testing. Correlation and regression. Random process. Markov's chains.

Optimization methods: Objective functions. Constraints. Linear optimization. Geometrical and simplex method. Dual problem. Nonlinear optimization. One-dimensional optimization. Multidimensional nonlinear optimization. Method coordinate and steepest descent. Newton method. Multicriteria optimization. Vector objective multicriteria function and constraints. Ideal solutions and marginal solutions. Pareto optimum. Global criteria method and method with weighted coefficients.

Calculus of Variations: Introduction. Functionals and Extremals. Euler-Lagrange equations. Extremal problem with constrains in the form of equalities and inequalities. Necessary and sufficient condition of extremum. Some classical variational problems. Various types of functionals. Raylegh-Ritz approximation method. Isoperimetric problems. Hamilton's principle. Two-dimensional variational problems.

The mathematical principles of geometric modelling: Mathematical foundations of geometric modelling. Modelling of smooth objects in the plane, curves representation, rational models. The geometry of the surface. Modelling surfaces. Surfaces of free-form. 3D wire - frame, surface and solid models. Parametric and feature-based modelling.

Language of Instruction

☒Serbian (complete course) ☒ English (complete course) ☐ Other _____ (complete course)

☐Serbian with English mentoring ☐Serbian with other mentoring _____

Assessment Methods and Criteria

Pre exam Duties	**Points**	**Final Exam**	**Points**
Activity During Lectures		**Written Examination**	**50**
Practical Teaching		**Oral Examination**	**Max. 50**
Teaching Colloquia		**Overall Sum**	**100**

***Final examination mark is formed in accordance with the Institutional documents**