Program of exam on continuous mathematics
(2023/2024 year, 1 course 2 semester, group Eng-1)

Compiled by M. E. Abramyan

1. THE BASIC THEOREMS OF DIFFERENTIAL CALCULUS.
   Local extrema of functions. Fermat's theorem. Rolle's theorem, Lagrange theorem, and Cauchy's mean value theorem.
2. TAYLOR'S FORMULA.
   Taylor's formula for polynomials and for arbitrary differentiable functions. Various representations of the remainder term in the Taylor's formula. Expansions of elementary functions by the Taylor's formula in a neighborhood of zero.
3. APPLICATION OF DIFFERENTIAL CALCULUS TO THE STUDY OF FUNCTIONS.
   Local extrema of functions. Convex functions. Inflection points of a function. Asymptotes.
4. ANTIDERIVATIVE AND INDEFINITE INTEGRAL.
   Definition of an antiderivative and indefinite integral. Table of indefinite integrals. The simplest properties of an indefinite integral. Change of variables in an undefined integral. Formula of integration by parts.
5. INTEGRATION OF RATIONAL FUNCTIONS.
   Auxiliary information from algebra. Integration of terms in the partial fraction decomposition of a rational function.
6. DEFINITE INTEGRAL, DARBOUX SUMS, AND INTEGRABILITY CRITERION.
   The problem of finding the area of a curvilinear trapezoid. Definition of a definite integral. A necessary condition for integrability. Darboux sums and Darboux integrals. Integrability criterion in terms of Darboux sums. Classes of integrable functions.
7. PROPERTIES OF A DEFINITE INTEGRAL.
   Properties associated with integrands. Properties associated with integration segments. Estimates for integrals. Mean value theorems for definite integrals.
8. INTEGRAL WITH VARIABLE UPPER LIMIT. NEWTON-LEIBNIZ FORMULA.
   Integral with variable upper limit. Newton-Leibniz formula. Some methods for calculating definite integrals based on the Newton-Leibniz formula.
9. IMPROPER INTEGRALS.
   Tasks leading to the notion of an improper integral. Definitions of an improper integral. Properties of improper integrals. Absolute convergence of improper integrals. Properties of improper integrals of non-negative functions. Conditional convergence of improper integrals. Dirichlet test for conditional convergence of an improper integral.
10. NUMERICAL SERIES.
    Definition and examples. Absolutely convergent numerical series and their arithmetic properties. Comparison test and integral test of convergence. D'Alembert's test and Cauchy's test of convergence of numerical series.
11. ALTERNATING SERIES AND CONDITIONAL CONVERGENCE.
    Alternating series. Dirichlet's test and Abel's test of conditional convergence of a numerical series.
12. DIFFERENTIAL EQUATIONS.
    Basic notations. Directly integrable equations. Separable equations. Homogeneous equations. Linear equations. Bernoulli's equations.

The exam is in the form of a test. The test contains 40 questions that require either choosing one correct answer or all correct answers or entering the required text. Each question is rated 1 point.
The test is placed in the Moodle system on the course page:
https://edu.mmcs.sfedu.ru/course/view.php?id=443
The test duration is 120 minutes.
To be able to take the test, you must enroll in a course in the Moodle system.
The test will be available on the day of the exam.