«APPROVED»
Member of the Management Board,
Vice-Rector for Academic Affairs
NJSC «Al-Farabi KazNU»
_____ Kazmagambetov A.G.
«___» _____ 2025

The program of
the entrance exam for the group of educational programs of the Faculty of Mechanics and mathematics
for PhD degree
for foreign citizens to study on a paid basis

1. General Provisions

1.1 The program was drawn up in accordance with the Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018, No. 600 «On approval of the Model Regulations for admission to studies in educational organization, implementing educational programs of technical and vocational education» (hereinafter – the Standard Rules).

1.2. In Al-Farabi KazNU for educational programs of postgraduate education (doctoral studies) are admitted persons who have mastered educational programs of postgraduate education. The admission to the doctoral program is allowed to applicants who have a "Master's" degree.

1.3. Entrance examinations according to Annex 2 to the Standard Rules are held **in the format of an interview** for the following groups of educational programs:

- ✓ 8D05401 – Mathematics,
- ✓ 8D05404 – Fundamental and Applied Mathematics (ИМММ).
- ✓ 8D05405 – Computational Sciences and Statistics
- ✓ 8D06104 – Mathematical and Computer Modeling
- ✓ 8D05403 – Mechanics
- ✓ 8D07111 – Space Engineering and Technologies
- ✓ 8D07117– Robotic systems

1.4 For the organization and conduct of entrance examinations for admission of a foreign applicant by the decision of the rector of Al-Farabi Kazakh National University is creating an examination committee for the period of examinations.

The commission of entrance examinations for admission of a foreign applicant to KazNU includes employees of the Internationalization and Recruiting Department (hereinafter referred to as the Department) and the professor-teaching staff of KazNU.

1.5 In case a foreign applicant who meets the above requirements has no possibility to come to the University for an entrance interview, he has the opportunity to take it online.

1.6 Entrance exam in the form of oral conversation (interview) for admission to a foreign applicant are evaluated on a 100-point system. When enrolling on a paid basis, 75 points are counted.

1.7 Based on the results of the entrance exam, an interview protocol is drawn up in the prescribed form according to the requirements of the Department. The interview record is signed by the chairman and all members of the commission present and submitted to the Department.

1.8 The decision on admission is made by the University Admissions Committee on the results of the interview. The results of the entrance exam are announced on the same day.

1.9 Retaking the entrance exam is not permitted.

1.10. An appeal based on the results of the interview is provided within 24 hours.

2. Conducting the entrance exam in 2025

2.1 The interview is conducted in Russian, Kazakh and English. The oral interview also contains questions aimed at revealing the ability to learn, creative activity and critical thinking, personal qualities of the applicant.

2.2 An indicative list of interview topics:

1. The functions of one variable. The continuity of a function at a point. Local properties of continuous functions. Operations on continuous functions. Classification of function discontinuities. Equidistant continuous families of functions. Uniformly continuous families of functions. Arzel's theorem.
2. Surface integrals. Basic theorems of integral calculus.
3. The concept of the inverse function and the question statement. Prove the simplest version of the inverse function theorem. Formulate the inverse function theorem in the general statement. Taylor's formula for a function of many variables. Higher-order differentials.
4. An improper integrals. Uniform convergence of improper integrals depending on the parameter. Continuity, differentiation, and integration of the integral with respect to parameters.
5. Theory of series. Functional sequences and series, uniform convergence: signs of uniform convergence; The theorem on the slow transition to the limit; the theorems on continuity. The trigonometric Fourier series. The Dirichlet kernel. Riemann's Lemma. The basic convergence theorem of the trigonometric Fourier series. Orthonormal systems and generalized Fourier series. The Cauchy-Bunyakovsky inequality. Bessel's equality and inequality. Parseval's equality.
6. Definition of measurable functions. Actions on them. The Lebesgue integral for simple functions. General definition of the Lebesgue integral. Comparison of the Lebesgue integral with the Riemann integral.
7. Elements of functional analysis. Concepts of metrics and metric space. Axioms of metric space. Cauchy-Bunyakovsky, Helder, and Minkowski inequalities. Sets in metric spaces. The concepts of an open and closed sphere. The neighborhood of the point. A limited set. Open and closed sets and their properties.
8. Generalize the Cauchy criterion for sequences in metric spaces. The concept of replenishment of a metric space. An example of an incomplete metric space. Properties of convergent sequences in metric spaces.
9. Limit and continuity of functions in metric spaces. Continuity of a scalar product in a Hilbert space
10. Zeros of a holomorphic function. The uniqueness theorem. Classification of isolated singular points. Cauchy's deduction theorem. Calculation of integrals using deductions. Rouchet's theorem.
11. The concept of a Riemannian space. The principle of the argument. The principle of symmetry. Displaying fractional lines. Conformal isomorphism and automorphism of canonical domains. Cauchy's theorem. The Cauchy formula. Morer's theorem. The mean theorem. Maximum Modulus principle.
12. A homogeneous and nonhomogeneous linear ordinary differential equation of the nth order with constant coefficients. Fundamental decision system.
13. Systems of homogeneous and nonhomogeneous linear ordinary differential equations, properties of solutions. Ostrogradsky-Liouville formula.
14. The existence and uniqueness theorem for a solution of ODE.
15. Continuous dependence of the solution of the Cauchy problem on the initial values and parameters.
16. Green's function. Existence of a solution to a boundary value problem.

17. Statement of boundary value problems for a second-order linear ordinary differential equation.
18. Inhomogeneous systems of linear differential equations. The method of variation of arbitrary constants (Lagrange method).
19. The general method for entering the parameter. Lagrange and Clairot equations.
20. The Sturm-Liouville problem.
21. Ostrogradsky-Liouville formula for a system of inhomogeneous linear ordinary differential equations.
22. First-order differential equations resolved with respect to the derivative. First-order differential equations with separable variables.
23. First order differential equations resulting in equations with separable variables.
24. The subject of theoretical mechanics, basic concepts, and definitions. Point and rigid body kinematics. Methods for specifying the movement of a point. Speed and acceleration in curved motion. Expansion of acceleration along the axes of a natural trihedron.
25. Mechanical system.
26. Plano-parallel motion of an absolutely solid body
27. The motion of a rigid body about a stationary point.
28. Complex motion of a rigid body.
29. The motion of a free rigid body.
30. Complex motion of a point.
31. Basic definitions and axioms of statics.
32. System of convergent forces.
33. The theory of pairs.
34. General theorems of point dynamics.
35. Types of relations.
36. Virtual and true displacements.
37. Generalized coordinates, velocities, and forces.
38. Dalembert's principle.
39. Lagrange multiplier method.
40. Type II Lagrange equations. 41.
41. The subject matter of continuum mechanics, its main problems and variety of applications. 42.
42. Elements of tensor calculus and analysis.
43. Kinematics of continuous media.
44. Theory of deformation.
45. Basic theorem and equation of continuum dynamics.
46. Equations of equilibrium of a medium.
47. Classical models of continuous media.
48. Model of an elastic body.
49. Foundations of hydrostatics
50. General theory of motion of ideal liquids and gas.
51. The equation of energy in adiabatic motion of an ideal gas. 52.
52. One-dimensional stationary motion of ideal gas in a tube of variable cross-section.
53. Dynamics of a viscous incompressible fluid.
54. The motion of a viscous incompressible fluid in a circular tube.
55. Laminar and turbulent motion.
56. Properties of isotropy and anisotropy.
57. Basic problems in the theory of elasticity.
58. The Clapeyron equation and the singularity theorem for the solution of the main problems of linear elasticity theory.
59. Flat problems in elasticity theory.
60. Basic relations of the moment theory of elasticity.

61. A model of a perfectly plastic body.
62. Laws of formation of plastic deformations.
63. Flat problems of plasticity theory.

2.3 List of recommended literature for preparation:

1. V.A. Ilyin, E.G. Pozniak. Fundamentals of Mathematical Analysis. Part I.M. : "Science" 1982. 616 p.

2. V.A. Ilyin, E.G. Pozniak. Fundamentals of Mathematical Analysis. Part II. M.: "Science" 1980. 447 p.

3. Temirgaliev NT, Analysis of Mathematics, vol. I-III, 1987,1991 zh.zh.

4. V.A. Zorich, Mathematical Analysis, Parts I, II. 2017.

5. Akhmetkaliev E. Mathematical skills. Almaty, RBC,

6. Nauryzbaev KZ, Nakty analysis, Almaty, "Kazakh university",2004.

7. Kolmogorov AN, Fomin SV, Elements of function theory and functional analysis, - M.:Science,1989

8. Lusternik LA,Sobolev VI. Short course of functional analysis.- M.: "Higher school",

9. Trenogin VA Functional analysis. - M.: Science,

10. Suleimenov Zh. Differential teacher course, Oqulyk. Almaty, Kazakh University, 2009.- 440 p.

11. Kadykenov BM Resistances of differential windings. Almaty,

12. NM Matveev. Methods of integrating ordinary differential equations» 4th ed.Minsk: «Higher School». 1974. 768 p.

13. Petrovsky IG Lectures on the Theory of Ordinary Differential Equations, M.,

14. Pontryagin LS. Ordinary Differential Equations. M., 1974.

15. Krasnov ML, Kiselev AI, Makarenko GI. Ordinary Differential Equations. Problems and examples with detailed solutions. M.: USSR, 2005.- 256 p.

16. Butenin NW, Lunz YL, Merkin DR. Course in Theoretical Mechanics. – 11th ed., ster. - C-Pb: Lan, 2009. - 736 p.

17. Buchholz NN. A basic course in theoretical mechanics. Ch.1. – 10th ed., ster. - C-Pb: Lan, 2009. - 480 p.

18. Buchholz NN. A basic course in theoretical mechanics. Ch.2. – 7th ed., ster. - C-Pb: Lan, 2009. - 336 p.

19. Markeev AP Theoretical Mechanics. - M.-Izhevsk: NTS "Regular and chaotic dynamics", 2001. - 592 p.

20. Yablonsky AA, Nikiforova VM. Course in Theoretical Mechanics. Static, kinematics, dynamics. - M.: KnoRus, 2011. - 608 p.

21. Borisov AV, Mamaev IS. Dynamics of the rigid body. - M.-Izhevsk: NIC RHD, 2001. - 384 p.

22. Polyakhov NN, Zegzhda SA, Yushkov MP. Theoretical Mechanics. - M.: Higher education institution, 2000. - 592 p.

23. Rabotnov Yu.N. Mechanics of a deformable rigid body. - M.: Nauka, 1988. - 712 p.

24. Klyushnikov VD. Physical and mathematical foundations of strength and ductility. - M.: MSU, 1994. - 190 p.

25. Feodosiev VI Resistance of materials. - M.: Nauka, 1986. - 512 p.

26. Darkov AV, Shaposhnikov NI. Construction Mechanics. - M.: Nauka, 1986. - 368 p.

27. Smirnov AF. Construction Mechanics. Dynamics and Stability of Structures. - M.: Nauka, 1984. - 413 p.

28. Babakov NM Theory of oscillations. - M.: Drofa, 2004. - 591 p.

29. Tymoshenko SP. Strength and vibration of structural elements. - M.: Nauka, 1975. - 704 p.

30. Betchelor J . Introduction to Fluid Dynamics. – Moscow-Izhevsk; NIC «Regular and chaotic dynamics», 2004. – 768 p.

31. Sedov LI Cohesive environment mechanics: In 2 vols. Vol.1. 6th ed. ster. - St. Petersburg: Publishing house "Lan", 2004. - 528 p.

32. Sedov LI Mechanics of cohesive environment: – In 2 vols. Vol.2. 6th ed. ster. - SPb.: Publishing house "Lan", 2004. - 560s.

33. Loitjanski LG. Fluid and gas mechanics: A textbook for universities. 7th ed. ispr. - M.: Drofa, 2003. - 840s.

34. Ilyushin AA Cohesive Medium Mechanics. - M.: MSU, 1990. - 310 p.

35. Maze J . Theory and problems of mechanics of coherent media. – M.: Publishing house LKI. 2007. – 320 s.

36. Veretennikov VG, Sinitsyn VA. Theoretical mechanics (supplements to general sections). - M.: Izd-vo MAI, 1996. - 360 p.

37. Golubev Yu.F. Fundamentals of Theoretical Mechanics. - M.: Izd-vo MSU, 2000. - 719 p.

38. Loitjanski LG, Lurier AI. Course in Theoretical Mechanics. In 2 volumes. – C-Pb: Lan, 2006. – Ch.1: Statics, kinematics. – 352 s. – Ch.2: Dynamics. – 640 s.

39. Lidov ML. A course of lectures on theoretical mechanics. - M.: Physimalit, 2010. - 496 p.

40. Arkhangelsk Yu.A. Analytical Solid Body Dynamics. - M.: Nauka, 1977. 328 p.

41. Landau LD, Lifshitz EM. Hydromechanics. – M.: Nauka, 1986. –

42. Germain P . A Course in the Mechanics of Complex Media. General theory. – M.: Higher education institution, 1983.-399 s.

43. Monin AS, Yaglom AM. Statistical Hydromechanics. – M.: Science. 1965. ch.1. 639s.

44. Pope S.B. Turbulent Flows, – Cambridge University Press, Cambridge, UK, 2000. – 771 p.

45. Robert W. Fox, Alan T. McDonald, Philip J. Pritchad. Introduction to Fluid Mechanics, International Student Version. – 8th Edition, John Wiley&Sons Inc., 2011. – 896 p.

46. Kuznetsov VR, Sabelnikov VA. Turbulence and burning. - M: Nauka, 1986. - 287 p.

47. Kernstein IM. et al. Fundamentals of Experimental Fracture Mechanics. - M.: MSU, 1989. - 140 p.

48. Rabotnov Yu.N. Introduction to destruction mechanics. - M.: Nauka, 1987. - 80 p.

49. Parton VZ. The mechanics of destruction. From theory to practice. - M.: Nauka, 1990. - 240 p.

3. Scale and assessment criteria of the entrance examination for admission to the doctoral program for foreign citizens on a fee-paying basis:

Number of points	Compliance criteria
90–100 points «Excellent»	Demonstrates knowledge of the fundamental processes within the studied subject area; depth and completeness of addressing the issue; logically and sequentially expresses own opinion on the discussed problem; possesses conceptual-categorical framework, scientific terminology; logical coherence of the answer, adherence to the norms of contemporary scientific language.
80–89 points «Good»	Competent use of scientific terminology; mastery of conceptual-categorical framework; problem-oriented presentation of formulated questions; occasional errors in presenting factual material; incompleteness in presenting scientifically established facts within the scope of questions; logical coherence of the answer, adherence to the norms of contemporary scientific language.
75–79 points «Satisfactory»	Insufficient use of scientific terminology; inadequate mastery of conceptual-categorical framework; ability to address only one of the problems formulated in the questions; errors in presenting factual material; superficial knowledge of the subject area; violation of logical coherence in the answer, norms of contemporary scientific language.
0–74 points «Unsatisfactory»	Absence of necessary scientific terminology in the answers; descriptive presentation of discussed issues, inability to identify and present problems; gross errors in presenting factual material; lack of knowledge of historiography of the studied subject area.