«APPROVED»
Member of the Management Board,
Vice-Rector for Operations
NJSC «Al-Farabi KazNU»
_____ Duisenov E.E.
«__» _____ 2024

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 – Robotic systems
- ✓ 8D07117– Space Engineering and Technologies

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 Office (hereinafter referred to as the Office) 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 Office. The interview record is signed by the chairman and all members of the commission present and submitted to the Office.

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.

1.10n appeal against the results of the interview is not considered.

2. Conducting the entrance exam in 2024

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. Poznyak. Fundamentals of mathematical analysis. Part I. M.: "Science" 1982. 616 P.

2. V.A. Ilyin, E.G. Poznyak. Fundamentals of mathematical analysis. Part II. M.: "Science" 1980. 447 P.

3. Temirgaliev N.T., Mathematical analysis, vol. I-III, 1987.1991 J.zh.

4. V.A. Zorich, Mathematical analysis, Part I, II. 2017

5. Akhmetkaliev E. Matematikalyk taldau. Almaty, RBK, 1997.

6. Nauryzbayev K.Zh., National analysis, Almaty, "Kazakh University",2004.

7. Kolmogorov A.N., Fomin S.V., Elements of the theory of functions and functional analysis, -M.:Nauka,1989

8. Lyusternik L.A., Sobolev V.I. A short course in functional analysis. - M.: "Higher School", 1982

9. Trenogin V.A. Functional analysis. - M.: Nauka,1967.

10. Suleimenov J. Differentialdyk tendeuler courses, Okulyk. Almaty, Kazakh University, 2009.- 440 b.

11. Kadykenov B.M. Differentialdyk teideulerdin yesepteri men zhattygulary. Almaty, 2002.

12. N.M.Matveev. Methods of integration of ordinary differential equations" 4th ed.Minsk: "Higher School". 1974. 768 p.

13. Petrovsky I.G. Lectures on the theory of ordinary differential equations, Moscow, 2012.

14. Pontryagin L.S. Ordinary differential equations. M., 1974.

15. Krasnov M.L., Kiselev A.I., Makarenko G.I. Ordinary differential equations. Tasks and examples with detailed solutions. M.: URSS, 2005.- 256 p.

16. Butenin N.V., Lunts Ya.L., Merkin D.R. Course of theoretical mechanics. – 11th ed., ster. – S-Pb: Lan, 2009. – 736 p.

17. Buchholz N.N. The basic course of theoretical mechanics. Part 1. – 10th ed., ster. – S-Pb: Lan, 2009. – 480 p.

18. Buchholz N.N. The basic course of theoretical mechanics. Part 2. – 7th ed., ster. – S-Pb: Lan, 2009. – 336 p.

19. Markeev A.P. Theoretical mechanics. – M.-Izhevsk: SIC "Regular and chaotic dynamics", 2001. – 592 p.

20. Yablonsky A.A., Nikiforova V.M. Course of theoretical mechanics. Statics, kinematics, dynamics. – M.: KnoRus, 2011. – 608 p.

21. Borisov A.V., Mamaev I.S. Dynamics of a solid body. – M.-Izhevsk: SIC RCD, 2001. – 384 p.

22. Polyakhov N.N., Zegzhda S.A., Yushkov M.P. Theoretical mechanics. – M.: Higher School, 2000. – 592 p.

23. Rabotnov Yu.N. Mechanics of a deformable solid. – M.: Nauka, 1988. – 712 p.

24. Klyushnikov V.D. Physical and mathematical foundations of strength and plasticity. - M.: Moscow State University, 1994. – 190 p.

25. Feodosiev V.I. Resistance of materials. – M.: Nauka, 1986. – 512 p.

26. Darkov A.V., Shaposhnikov N.I. Construction mechanics. – M.: Nauka, 1986. – 368 p.

27. Smirnov A.F. Construction mechanics. Dynamics and stability of structures. – M.: Nauka, 1984. – 413 p.

28. Babakov N.M. Theory of oscillations. – M.: Bustard, 2004. – 591 p.

29. Timoshenko S.P. Strength and vibrations of structural elements. – M.: Nauka, 1975. – 704 p.

30. Rakisheva Z.B., Sukhenko A.S. Textbook on Theoretical Mechanics – 2d ed. – Almaty: Qazaq university, 2017. – 354 p.

31. Betchelor J. Introduction to fluid dynamics. – Moscow — Izhevsk; SIC "Regular and chaotic dynamics", 2004. – 768 p.

32. Sedov L.I. Mechanics of a continuous medium: In 2 vols. Vol. 1. 6th ed. erased. - St. Petersburg: Publishing house "Lan", 2004. – 528 p.

33. Sedov L.I. Mechanics of a continuous medium: – In 2 vols. Vol.2. 6th ed. erased. – St. Petersburg: Lan Publishing House, 2004. – 560c.

34. Loitsyansky L.G. Mechanics of liquid and gas: Textbook for universities. 7th ed. ispr. – M.: Bustard, 2003. – 840s.

35. Ilyushin A.A. Mechanics of a continuous medium. – M.: Moscow State University, 1990. – 310 p.

36. Maze J. Theory and problems of continuum mechanics. – M.: Publishing House LKI. 2007. - 320 p.

37. Veretennikov V.G., Sinitsyn V.A. Theoretical mechanics (additions to general sections). – M.: Publishing House of MAI, 1996. – 360 p.

38. Golubev Yu.F. Fundamentals of theoretical mechanics. – M.: Publishing House of Moscow State University, 2000. – 719 p.

39. Loitsyansky L.G., Lurie A.I. Course of theoretical mechanics. In 2 volumes. – S-Pb: Lan, 2006. – Part 1: Statics, kinematics. – 352 p. – Part 2: Dynamics. – 640 p.

40. Lidov M.L. Course of lectures on theoretical mechanics. – M.: Fizmatlit, 2010. – 496 p

. 41. Arkhangelsky Yu.A. Analytical dynamics of a solid. – M.: Nauka, 1977. 328 p.

42. Landau L.D., Lifshits E.M. Hydromechanics. – M.: Nauka, 1986. –

43. Germain P. Course of continuum mechanics. General theory. – M.: Higher School, 1983.-399 p.

44. Monin A.S., Yaglom A.M. Statistical hydromechanics. – M.: Nauka. 1965. part 1. 639c.

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

46. 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.

47. Kuznetsov V.R., Sabelnikov V.A. Turbulence and gorenje. Moscow: Nauka, 1986. – 287 p.

48. Kernstein I.M. et al. Fundamentals of experimental mechanics of destruction. – M.: Moscow State University, 1989. – 140 p.

49. Rabotnov Yu.N. Introduction to the mechanics of destruction. – M.: Nauka, 1987. – 80 p.

50. Parton V.Z. 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.