Institute of Fundamental Technological Research
Polish Academy of Sciences

Examination Issues

Admission to the Doctoral School of IPPT PAN is determined by the result of the competitive examination. The assessment is made by the Examination Commission appointed by the Head of the Doctoral School of IPPT PAN. The exam is a test of the candidate's academic qualifications and predispositions for research work.

For all research directions:

• MATHEMATICS (level of studies at universities of technology)

Elements of analytic geometry and linear algebra,

Differential and integral calculus,

Ordinary differential equations of the first and second order

Theory of probability

Literature:

E. Kreyszig, Advanced Engineering Mathematics, JOHN WILEY & SONS, INC. 2011
A. D. Polyanin, A.V. Manzhirov, Handbook of mathematics for engineers and scientists, Chapman & Hall/CRC November 27, 2006
J. Bird, Engineering Mathematics, Elsevier, 2007
W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Part A and B, PWN 2009 (or other issue)

• ENGLISH LANGUAGE

Translation of a technical text

Major subjects depending on the discipline:

• MECHANICAL ENGINEERING

Fundamentals of continuum mechanics

Fundamentals of the theory of elasticity and of the theory of plasticity

Tensor analysis

Stress/strain analysis

The laws of conservation of mass, momentum and spin

Elastic and plastic behaviour of materials

Elasticity and thermodynamics

Literature:

Y.C. Fung, Foundations of Solid Mechanics, Prentice Hall Inc. 1965, Chapters: 1, 3, 4, 5, 6, 12
Y.C. Fung, Podstawy mechaniki ciała stałego, PWN, 1969, Rozdział: 1, 3, 4, 5, 6, 12.

• FUNDAMENTALS OF FLUID MECHANICS

Introduction to fluid dynamics

Ideal fluid

Viscous fluid

Dynamics of a fluid element

Incompressible fluid

Hydrodynamic similarity

Stokes law

Literature:

L. D. Landau, E. M. Lifshitz, Fluid Mechanics, Pergamon Press, Oxford, 1987, Chapters 1-20

L. D. Landau, J.M. Lifszyc, Hydrodynamika, Wydawnictwo Naukowe PWN, Warszawa, 2009, Rozdziały 1-20

• MATERIAL ENGINEERING

Physicochemical fundamentals of material formation

Material structures and methods of their characterization

Examination of physical, chemical and mechanical properties of single- and multi-component materials

Behaviour of materials under operating loads

Designing materials.

LITERATURE

Michael Ashby, Hugh Shercliff i David Cebon, Inżynieria materiałowa Vol.1 and 2, Wydawnictwo Galaktyka, 2011

Chapters of Vol. 1: 1.2, 2.2-2.6, 3.2-3.4, 4.2, 4.4, 6.2-6.5, 8.2-8.5, 9.3-9.6, 10.2-10.3, 11.2-11.4.

Chapters of Vol. 2: 13.2-13.5, 17.2-17.6, 19, PW1, PW2.

Michael Ashby, Hugh Shercliff i David Cebon Materials: Engineering, Science, Processing and Design, Elsevier Ltd. Oxford (wersja oryginalna)

Sections: 1.2, 2.2-2.6, 3.2-3.4, 4.2, 4.4, 6.2-6.5, 8.2-8.5, 9.3-9.6, 10.2-10.3, 11.2-11.4. 13.2-13.5, 17.2-17.6, 19, GLU1, GLU2.

• AUTOMATICS, ELECTRONICS AND ELECTROTECHNICS

Nanofotonics

Propagation of optical waves

Reflection and refraction of optical waves

The phenomenon of total internal reflection

Propagation in layered media

Optical Gauss' beams

Basic LITERATURE

M. Born and E. Wolf, Principles In Optics, University Press, Cambridge, Chapter 1

D. Marcuse, Light Transmision Optics, Van Nonstrand, New York, Chapters 1 and 6

Auxiliary LITERATURE
H. A. Haus, Waves and fields in optoelectronics, Prentice-Hall, Englewood Cliffs, Chapters 1, 2 and 5.
Landau, Lifszyc, Elektrodynamika ośrodków ciągłych, PWN, Warszawa, Chapter 10
L. M. Brekhovskikh, R.T. Beyer, Waves in Layered media, Academic, New York, Chapter 1.

• COMPUTER SCIENCES IN ENGINEERING AND TELECOMMUNICATION

Computer methods in mechanics

Basics of computer arithmetic

Numerical optimization

Solving systems of linear equations

Numerical integration of ordinary differential equations

Solving nonlinear equations

Fast Fourier Transform

Literature:

J. Szmelter, Metody komputerowe w mechanice, WNT, 1980, Rozdziały 1 - 7.
D. Kincaid, W. Cheney, Analiza numeryczna, WNT Warszawa 2006, rozdziały 1-5, 6.13, 8.0-8.5, 11.
D. Kincaid, W. Cheney, Numerical Analysis: Mathematics of Scientific Computing, American Mathematical Society, 3rd ed, 2002, Chapters *1-5, 6.13, 8.0-8.5, 11.*

• BIOMEDICAL ENGINEERING

Estimation methods of parameters of the mathematical models (the greatest credibility, the Bayes method)

Fundamental methods of data analysis (linear regression, logistic regression and other classification methods)

Kinetics of enzymatic reactions (Michaelis-Menten's equation, Hill's equation)

Modelling of gene regulation networks (deterministic and i stochastic equations, Gillespie's algorithm)

Biomaterials in Medical Applications

Literature:

Hastie, Trevor, Robert Tibshirani, and Jerome Friedman. *The elements of statistical learning: data mining, inference, and prediction*. Springer Science & Business Media, 2009.
Alon, Uri. *An introduction to systems biology: design principles of biological circuits*. CRC press, 2019.
Munsky, Brian, Karen Tkach Tuzman, Dirk Fey, Maciej Dobrzynski, Boris N. Kholodenko, Sarah Olson, Jianjun Huang et al. *Quantitative biology: theory, computational methods, and models*. The MIT Press, 2018.
Biomedical Materials, Roger Narayan (editor), Springer 2009

• BIOMEDICAL ENGINEERING - Ultrasounds (or Acoustics)

Propagation of ultrasonic waves

Wave propagation velocity

Wave frequency

Wave power and intensity

Impedance of the acoustic medium

Reflection / refraction of waves at the border of media with different acoustic impedance

Basic LITERATURE
L. M. Brekhovskikh, R.T. Beyer, Waves in Layered media, Academic, New York, Chapter 1
Auxiliary LITERATURE
A. Nowicki, Podstawy ultrasonografii dopplerowskiej, PWN, Warszawa, 1995, Chapter 1
A. Nowicki, Wstęp do ultrasonografii, Medipage, Warszawa, 2003, Chapter 1.
A. Śliwiński, Ultradźwięki i ich zastosowanie, WNT, Warszawa, 2001, Chapters: 2.2, 2.4, 3.1, 3.2.

The result of the qualification procedure will be available at the Secretariat of the Doctoral School of IPPT PAN.