PÁZMÁNY PÉTER CATHOLIC UNIVERSITY
FACULTY OF INFORMATION TECHNOLOGY AND BIONICS
H-1083 Budapest, Práter u. 50/a
Tel: +36 1 8864 726; Email: registrars.office@itk.ppke.hu

Entrance examination topics

Computer Science Engineering MSc

Physics

1. Inductive way to Maxwell equation sand the Maxwell equations
2. Kirchhoff equations
3. Transmission lines
4. Linear antennas and antenna arrays
5. Motion of charge carriers in electromagnetic
6. Basics of quantum mechanics
7. Quantum statistics
8. Elements of solid state physics
9. Basics of semiconductor physics
10. Quantum optics and quantum electronics

Recommended literature:
N. Gershenfeld, *The Physics of Information Technology*. Cambridge University Press, 2000.
J. D. Jackson, *Classical Electrodynamics*. J. Wiley, 1998.

Electronics

1. Concentrated parameter circuits, building block of an electrical circuits: linear and non-linear building blocks. Kirchhoff equations; network specification by graphs and by incidence matrix, Telligent theorem.
2. Generation of circuit equations, the solution of the DC equation. Thévenin and Norton theorems
3. Solution of the circuit equations in time domain, circuit simulator programs.
4. Application of Laplace transformation in time domain Impulse response calculation of linear circuits.
5. Analysis of linear circuits in frequency domain, Bode diagrams.

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6. Basics of nonlinear circuits, Boolean circuit, amplifiers and chaotic circuits

7. Some problems of Boolean circuit design, speed, power, area, low power systems, DeMorgan-theorem, disjoint normal form.

Recommended literature:
Leon O. Chua – Pen-Min Lin, *Computer-aided Analysis of Electronic Circuits*. Prentice Hall, Englewood Cliffs, 1975.
Daniel Menge, *Analysis and Synthesis of Logic Systems.* Artech House, 1986, p. 1-48.

Computer Science

1. Representation of information

2. ALU (its components, functions)

3. Arithmetic operational units

4. Digital building blocks (register, ALU, MUX, encoders)

5. Process of instruction execution

6. Control units

7. Memories (types, properties)

8. Input / Output units, buses

9. RISC and CISC computer architectures

10. Basic data types (Stack (LIFO), Queue (FIFO), Priority Queue, Lists). Representation, implementation and operations.

11. Data storage and retrieving (Heap, Binary search tree, B-tree, Hash table)

12. Sorting algorithms (comparison based): Bubble sort, Insertion sort, Quicksort. Algorithms and their computational complexity

13. Basic components of programming languages: data types, control statements, function calls, and parameters. Support of parallel programming.

14. Object oriented programming: Class, Object. Creating objects, initialization, inheritance, polymorphism, dynamic binding, abstract class.

15. Software development methodologies. Design and quality aspects. The role of the UML in software design. Testing software.

16. Components and tasks of database management systems

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17. Basics of relational database management systems: Concepts: entity, relationship, relational model and relational algebra.

Recommended literature:

- Topics 1-9
  - L. Howard Pollard, *Computer design, and architecture*. Prentice Hall; 1st edition (July 1, 1997) , ISBN: 9780131672550
- Topics 10-12
  - Cormen, T. H.–Leiserson, C. E.–Rivest, R. L.–Stein,C.: *Introduction to Algorithms*. MIT Press, 2009 ISBN: 9780262033848
- Topics 13-14
  - Michael L. Scott: *Programming Language Pragmatics*. Morgan Kaufmann; 4th edition (December 25, 2015); ISBN: 9780124104099
  - Ian Sommerville: *Software Engineering (10th Edition)*. Pearson; 10th edition (April 3, 2015), ISBN: 9780133943030;
- Topics 15-17
  - Avi Silberschatz, Henry F. Korth, S. Sudarshan: *Database System Concepts*. McGraw-Hill Education; 6th edition (January 27, 2010), ISBN: 9780073523323

Mathematics

1. Real numbers. Sequences and series of numbers. Complex numbers.

2. Functions of real variable. Derivative .Taylor's formula.

3. Riemann integral of a funtion. Fundamental theorem of calculus. Newton-Leibniz's formula.

4. Differential equations. Linear systems.

5. Power series. Taylor's expansion. Trigonometric series

6. Functions of more independent variables. Continuity and limits. Differentiability and partial derivatives. Taylor's theorem. Maximum and minimum values.

7. Multiple integrals. Change of variables in multiple integrals . Path integral of a vector field.

8. The Fourier integral. Inverse Fourier transform. Time- and frequency domain descriptions.

9. Complex functions. Line integral of complex functions. Zeros and poles.

10. Vector spaces. Linearly Independent Sets, Bases. Coordinate Systems. Dimension.

11. Vector algebra.2d and 3d Vectors:Inner Product, Cross-Product, Mixed Product.

12. Matrix Operations: addition, multiplication, transpose. Inverse of a Matrix.

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13. Vector Equations of a linear system of equations. The Matrix Equation Ax = b

14. Determinants. Applications: Area, Volume and Determinants. Cramer's Rule.

15. Bilinear Function and its Matrix Representation. Quadratic Forms. Principal Axis Theorem.

16. Representing Graphs, Graph Isomorphism. Euler and Hamilton Circles. Trees

17. Propositional calculus. Basic and derived argument forms

18. Cardinality of Sets and Subsets. Countable and uncountable sets. Continuum Cardinality.

Recommended literature:

R. Courant – F. John: *Introduction to Calculus and Analysis I-II.* Springer.
D. C. Lay: *Linear Algebra and Its Applications*. University of Maryland, Pearson.
K. H. Rosen: *Discrete Mathematics with Applications*. Mcgraw Hill.
J. Stewart: *Calculus*. ISBN-13: 978-1285740621