

(1.) Course Title: INFPHD602 Complexity (complex exam preparatory)	Credits: ...6
Course Classification: Compulsory Elective (<i>a nem kívánt törlendő!</i>)	
Theoretical or Practical Nature of the Course, 'training character'¹³: Theoretical (credit%)	
Type of Class: practice and number of hours: 2 /weeks... in the given semester, <i>(If the course is not (only) taught in Hungarian, then the language: ...English.....)</i> Additional (specific) methods and characteristics² used in delivering the knowledge (<i>if any</i>):	
Assessment Method (Exam / Midterm Grade / Other³): Exam Additional (specific) methods⁴ applied in knowledge assessment (<i>if any</i>): -.	
Course Placement in Curriculum (Semester Number): 4....	
Prerequisites (<i>if any</i>): -.	
Course Description: A concise yet informative description of the knowledge to be acquired.	
The Turing machine. Definition and existence of the universal Turing machine. The k-tape Turing machine can be simulated with 1 tape in $O(N^2)$ time. The RAM machine. Recursive and recursively enumerable languages. Time- and space-bounded language classes. $DSPACE(f(n))$, $DTIME(f(n))$, P, $PSPACE$. Linear speedup theorem. For every recursive function f, there exists a recursive language that is not in $DTIME(f(n))$ (i.e., there is an arbitrarily hard language). The non-deterministic Turing machine. Non-deterministic language classes. Definition of NP-completeness. Cook's theorem: The SAT is NP-complete Random algorithms, Random complexity classes, randomized Turing machine. Random algorithm for deciding the existence of a complete matching in a pairwise graph. Prime tests: weak trials, Fermat test, Miller-Rabin test. The Agrawal-Kayal-Saxena test: the primes are in P (without proof). LOGSPACE, NLOGSPACE. ACCESSIBILITY is in NLOGSPACE, PALINDROMES in LOGSPACE. ACCESSIBILITY is in $DSPACE(\log^2 n)$. Savitch's theorem. $PSPACE$-completeness, the TQBF language. Interactive games and proofs (Babai, Micali, Rackoff). The IP class. Shamir's theorem: $IP=PSPACE$. Communication games, the Mehlhorn-Schmidt theorem. Non-deterministic communication complexity. Randomized communication games. The Aho-Ullman-Yannakakis theorem Boolean networks: size, depth, degree of in-degree. Uniform and non-uniform AC and NC. Boolean networks of finite depth. The Yao-Hastad theorem. Parallel computers, PRAM. Element difference in constant time. MAX calculation with n^2 and n processors. Sorting with n processors in $O(\log^2 n)$ time. Scalar product, matrix multiplication in parallel. Parallel calculation of the shortest paths between each pair of vertices in a weighted edge graph. The Brent principle; application when we have fewer processors.	

2-5 Most Important Required and Recommended Literature

List of required and recommended literature (notes, textbooks) with bibliographic data (author, title, publication details, (possibly pages), ISBN).

Papadimitriou, C.H.: Computational Complexity, Addison-Wesley,
ISBN 0201530821, 9780201530827, 1994

List of Prescribed Professional Competencies and Competency Elements

(knowledge, skills, etc., KKK Section 8) that the course significantly contributes to developing (highlight the most important ones).

a) Knowledge

- Has a research-level understanding of the general and specific characteristics, major directions, and precisely developed boundaries of the subject area within the discipline, as well as the agreed and debated interrelations.
- Creatively comprehends the interrelations, theories, and conceptual frameworks and terminologies of the given field of study.¹
- Possesses research methodology knowledge necessary for independent research in the given discipline/field.

b) Skills

- Capable of creative analysis of the field, synthesizing comprehensive and specific interrelations with a new perspective, and conducting appropriate evaluative and critical activities.
- Able to apply and further develop the specialized learning and problem-solving methods of the field.
- Can creatively elaborate on the novel, previously unknown practical implications of theoretical issues.
- Capable of planning and executing new projects, conducting research in the field, and developing new techniques and approaches.
- Able to identify unforeseen professional problems and uncover the detailed theoretical and practical background necessary for their resolution at a research level.
- Can construct and communicate new relations relevant to the field, as well as comprehensive interrelations significant for personal and communal existence.

c) Attitudes

- Represents and further develops the relations that contribute to the process of human self-creation based on the field's characteristics.
- Possesses an interest and learning ability that enable identifying and solving currently unpredictable research problems in the field.
- Demonstrates a firm professional commitment, a continuous dedication to exploring new approaches, and an acceptance of the necessity for persistent effort.

d) Autonomy and Responsibility

- Builds and initiates new knowledge areas with creative independence and proposes new practical solutions.

¹Section 108, Article 37 of the National Curriculum Act (Nftv.) 37. lesson: a session (lecture, seminar, exercise, consultation) requiring the personal involvement of the instructor to fulfil the academic requirements specified in the curriculum, the duration of which is at least forty-five minutes and not more than sixty minutes.

² e.g. case studies, role play, thematic presentations, etc.

³ e.g. continuous debriefing, mid-year report

⁴ e.g. request for case studies, thematic papers, essays, business, organisational plans, etc.

- Participates in formulating theoretical and practical questions with a leadership role and high-level cooperation.
- Engages as an equal discussion partner with professionals in the field.
- Takes responsibility for raising and addressing new ethical questions concerning theoretical and practical aspects of the profession.

Course responsible (name, position, academic degree): ...Dr. Vince Grolmusz, professor, DSc.....

Instructor(s) involved in teaching the course (if any) (name, position, academic degree):
-