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COURSE DESCRIPTIONS

Code of course: **BMI-LOTD17-102E**

Title of course: **Logic, lecture**

Lecturer: **Péter Mekis**

General aim of the course:
The course provides a concise introduction to the basic concepts and methods of modern formal logic.

Content of the course:
The lectures will cover the following topics:

1. introduction: the concept of modern formal logic and its place in the foundational studies;
2. syntax and semantics of standard first-order languages;
3. first-order analytic trees and the decision problem;
4. first-order theories: basic concepts and methods;
5. Peano arithmetic: language, definitions, basic theorems, and the standard model;
6. standard first-order calculus: deductions and metatheorems;
7. soundness and completeness of the standard first-order calculus;
8. the compactness theorem and nonstandard models of Peano arithmetic;
9. the downward Löwenheim-Skolem theorem;
10. overview of Gödel's incompleteness results;
11. higher-order logic;
12. definite descriptions and semantic value gaps;
13. modal and intensional logic.

The topics may change during the course, in accordance with student demand. The Hungarian version of the course will be easier and covers less topics.

Grading criteria, specific requirements:
The course ends with an oral exam. After the last lecture, students will get the final list of the topics covered in the course. Logic masters students can pick two items of this list that they don't want to study. Other students can pick four such items. The exam will cover the rest of the topics.

Required reading:

- Lecture notes (updated during the course)
- Gamut, L. T. F., *Logic, Language, and Meaning*. Vol 1: *Introduction to Logic*. Chicago UP, 1991.

Mendelson, E., *Introduction to Mathematical logic* . 4th ed. Springer, 1997.

Code of course: **BMI-LOTD17-103E**

Title of course: **Foundations of mathematics**

Lecturer: **Alexa Gopaulsingh**

General aim of the course:
To demonstrate the set theoretic build-up of the number systems.

Content of the course:
Axioms of set theory; Russell's paradox; Relation, functions, equivalence classes and cartesian products; von Neumann construction of natural numbers, Properties of natural numbers, Peano axioms; Review of groups and group homomorphisms; Building the integers from the natural numbers; Building the Rationals from the Integers, Building the Reals from the Rationals using Dedekind cuts, Properties of Real numbers, Cardinality to measure size of sets, Properties of cardinality, Cantor–Schröder–Bernstein theorem.

Lastly if time permits, a discussion on generalising size from finite collections to infinite collections using cardinality: What principle(s) about size do we give up when generalising cardinality from finite sets to infinite sets?

Grading criteria, specific requirements:
The grade will be based on weekly homeworks and a final exam.

Required reading:
A Book of Set Theory by Charles C. Pinter.

Suggested further reading:
Introduction to Metamathematics by Stephen Cole Kleene.

Code of course: **BMI-LOTD17-202E.04**

Title of course: **Theories of meaning**

Lecturer: **Zsófia Zvolenszky**

Prerequisites:
– Students should be prepared to read and discuss materials in English. The language of instruction for the course is English.
– If this is your first philosophy of language course: the instructor's permission is required for taking the course.
– The first half of the semester (through mid-November) is an introduction to the philosophy of language; the second half (starting mid-November) will explore advanced topics in the philosophy of language. Depending on students' background, they may register for both halves of the course, or just one of them. To take only the second, "advanced topics" half of the course, the instructor's permission is required.

Requirements:
– 30–40 pages of reading each week
– at the beginning of (almost) every seminar, a short quiz (the 6 highest scores count towards 20% of the final grade)
– posting 2 questions/comments at the course discussion forum each week (the 6 best make up 20 % of the final grade), by 4 p.m. on Wednesday
– class participation (worth 15 %)
– writing 4 short (2-3-page-long) response papers during the semester (the best 3 of these go towards 30 % of the final grade)
– once during the semester, acting as MC (Master of Ceremonies) (this involves briefly introducing the readings as well as students' questions and comments, worth 15 %)

Course description:
Our words, sentences are about—refer to—things in the world: objects, people, events. Plausibly, the meanings of expressions play a central role in explaining this referential feature: for example, it is in virtue of the meaning of the word 'horse' that it refers to horses. But what exactly does this role played by meaning consist in? The answer is not at all straightforward. Consider these two sentences:
Mark Twain was a famous novelist.
Samuel Clemens was a famous novelist.
How does the meaning of the first sentence differ from the meaning of the second? After all, both are about the same individual: who was called Samuel Clemens but became famous under the pseudonym 'Mark Twain'. Yet—according to Gottlob Frege—the two sentences cannot have the same meaning because someone may rationally believe one (the first, say), without believing the other. This is what Frege's "puzzle" consists in, providing the starting point for 20th-century philosophy of language. In the seminar, our aim is to gain a greater understanding of the nature of meaning, and its relation to reference, truth, communication.

Readings:

Alongside seminal texts in the philosophy of language (by Frege, Grice, Kripke, Strawson, Austin, Searle, Putnam), and a recent survey article on racism in language use (by Langton, Haslanger and Anderson), one more reading will function as a "textbook":

- W. Lycan (ed.) 2008: *Philosophy of Language: A Contemporary Introduction*, 2nd edition. London: Routledge (referred to as 'Lycan' in the schedule below). Excerpts from selected chapters will be assigned.

Electronic copies of all required readings are available in the Gmail Drive for the course. The seminal texts (by Frege, Grice, Kripke and Strawson) can also be found in the following anthology:

- P. Martinich and D. Sosa (eds.) 2012: *The Philosophy of Language*, 6th edition. Oxford: OUP. (Previous editions are ok, except for Frege's "Sense and Reference", which appears in a different translation in earlier editions.)

Langton–Haslanger–Anderson's survey article "Language and Race" can be found in the following anthology of essays:

- G. Russell and D. G. Fara (eds.) 2012: *Routledge Companion to the Philosophy of Language*. New York: Routledge.

The bulk of the articles can also be found in the following anthology:

–P. Martinich (ed.) 1996: The Philosophy of Language. Oxford: OUP.

About the requirements

You should come to class ready to discuss the readings, having read them all, preferably several times—reading philosophy can be tricky (the "textbook" readings should make it much easier to read the classic papers by Frege, Russell, etc.) You should **post 2 questions/comments on the readings by 4 p.m. on Tuesday**. Being **Master of Ceremonies** (when it's your turn) involves: **(i) giving a brief, 3-minute summary of the readings**, selecting maximum ten of the student questions/comments posted by students, grouping them by topic**, compiling a handout of the questions/comments that you bring to class printed out**. Be sure to include the authors of the questions, so we know who made which comment.

In the **response paper**, you should focus on critical assessment, don't just summarize the readings. Instead select an argument or claim that you consider interesting and critique it.

Three useful sites about writing response papers:

http://www.davidhildebrand.org/uploads/3/2/1/2/32124749/hildebrand_how_to_write_a_short_critical_paper.pdf

http://web.mit.edu/sts001/www/responsetips.pdf

http://www.jimpryor.net/teaching/guidelines/writing.html (this one is intended for a longer piece than ours).

Bring the response papers to class printed out or send them by email to all participants in advance so we can access them during your presentation. It's a good idea to get started early on with the four response papers so you can get feedback based on which you can make your next response paper even better. For this reason **you can only hand in one response paper at a time, and by mid-April you should hand in at least two of your response papers.**

Regular preparation, attendance and participation are required. To receive a grade, you must attend at least 7 seminars (including the one when you are M.C.-ing).

OTE THE MISSING SYMBOLS IN STANLEY!

The error is on page 402, replicated on page 418. On both pages, examples (1) and (2) are missing the square box for 'Necessarily'. (1) and (2) should read as follows:

(1) □(the number of planets is >/= 7)

(2) □ (9 >/= 7)

Code of course: **BMI-LOTD17-203E.01**

Title of course: **Metalogic**

Lecturer: **András Máté**

General aim of the course:

Prove the most important metatheorems of logic within a general framework

Content of the course:
Metalogic investigates properties of formalized theories (so as negation-completeness, semantical completenes, decidability, consistency) within the framework of some (formalized or at least fomalizable) theory. This course bases on the theory of canonical calculi by Imre Ruzsa and on the Markov algorithms. It extends to the construction of them, to their connection (interdefinability) and the demonstration of the well-known theorems of metalogic (Gödel's theorems, Church and Tarski theorem) within this framework in an abstract and very general form. We investigate some alternative frameworks and the philosophical importance of these theorems, too.

Grading criteria, specific requirements:
Test exam (problem solving).

Required reading:
Imre Ruzsa, *Introduction to Metalogic*. Budapest, 1993.

Code of course: **BMI-LOTD17-204E.1**

Title of course: **ZFC set theory**

Lecturer: **Amitayu Banerjee**

General aim of the course:
Getting acquainted with model theoretical techniques involving κ-complete, normal ultrafilters used in set theory and looking into applications outside set theory for example in logic, algebra or graph theory from a motivational perspective.

Contents of the course:
– Theory of Ultrafilters:
- ∗ Explanation of filters, ultrafilters, κ-complete, non principal and normal ultrafilters, regular and uniform ultrafilters.
- ∗ Push–forward, integrated and limit ultrafilters. ∗ Ultrafilter orderings.
- ∗ Applications of Ultrafilters outside set theory (eg, Arrows impossibility theorem, Ramsey theorem, Erdos De Bruijn theorem, Compactness theorem of propositional logic and FOL).

– Ultrapowers and elementary embeddings.
- ∗ Explaination of ultraproducts, ultrapowers, Los Lemma and elementary embedding.
- ∗ Defining measurable, strongly compact and supercompact cardinals.
- ∗ (Optional∗) Saturation and Keisler Shelah Theorem.
- ∗ Applications of ultraproducts outside set theory (eg, Expansion theorem, Compactness theorem of FOL, Upward Loweinheim Skolem theorem, Non–standard models).

– Direct Limit of Models and examples of direct limits of algebraic structures.
– Iterated ultrapowers and 2 models (L[U] and L[U]).
- ∗ Explanation of Iterated ultrapowers using ultrapowers, elementary embeddings and direct limits. Factor Lemma, Gaifman theorem and Representations of iterated ultrapowers.
- ∗ L[U] for a κ- complete non principal ultrafilter U, L[U] for U a sequence of normal κ-complete ultrafilters. – Extenders.
- ∗ Explanation of (κ, λ)-extenders a special system of ultrafilters in 2 different ways, Defining strong cardinals.

Examination and evaluation system: Oral examination. Basic questions + Presenting a topic with full proof related to ultrafilters or presenting an important theorem with it's proof that we will cover in class. There will be a few problem solving sessions.

Bibliography: Chapters 7, 10, 17, 19, 20 of Jech's book on Set Theory. 1 2 MODELS OF SET THEORY 2 References [1] Thomas Jech (2003). Set Theory, Springer Monographs in Mathematics. Springer-Verlag, Berlin. The Third millennium edition revised and expanded. MR1940513.

Code of course: **BMI-LOTD17-207E.04**

Title of course: **Philosophy of Science I.**

Lecturer: **László E. Szabó**

General aim of the course:

Web site: http://phil.elte.hu/leszabo/PhilSci/2019-2020-2

The course provides an introduction to modern analytic philosophy of science. I shall focus on the central epistemological problems concerning empirical sciences like physics; and I shall discuss these issues on a formal/logical basis. Finally I sketch a naturalized philosophy of science based on what I call physico-formalist philosophy of mathematics -- an account for scientific knowledge, both a priori and empirical, within a purely physicalist ontology.

Content of the course:

- characterization of scientific knowledge
- science in social context
- traditional methodology of empirical science
- scepticism concerning empirical knowledge
- truth of fact vs. truth of reasoning dichotomy
- the Kantian tradition
- philosophy of logic and mathematics
- scientific theory as partially interpreted formal system
- semantics of scientific theory
- the physicalist approach
- meaning and truth
- holistic conclusions
- operationalism and the constitutive a priori
- empirical underdetermination
- scientific knowledge in the context of the natural world

Grading criteria, specific requirements:

Oral exam from the material of the lectures. Video records and the slides of the lectures will be available.

Required reading:

1. Alexander Bird: *Philosophy of Science* (Fundamentals of Philosophy), Routledge, 1998.
2. L. E. Szabó: Meaning, Truth, and Physics, In G. Hofer-Szabó, L. Wroński (eds.), *Making it Formally Explicit*, European Studies in Philosophy of Science 6. (Springer International Publishing, 2017) DOI 10.1007/978-3-319-55486-0_9. (Preprint: http://philsci-archive.pitt.edu/14769/)

Suggested further reading:

3. David A. Truncellito: Epistemology, Internet Encyclopedia of Philosophy, https://www.iep.utm.edu/epistemo/
4. Thomas Uebel: Vienna Circle, *The Stanford Encyclopedia of Philosophy* (Spring 2013 Edition), Edward N. Zalta (ed.) (http://plato.stanford.edu/entries/vienna-circle/)
5. John Vickers: The Problem of Induction, *The Stanford Encyclopedia of Philosophy* (Spring 2013 Edition), Edward N. Zalta (ed.) (http://plato.stanford.edu/entries/induction-problem/)
6. Robert Sinclair: Quine's Philosophy of Science, *Internet Encyclopedia of Philosophy* (http://www.iep.utm.edu/quine-sc)
7. L. E. Szabó: Mathematical facts in a physicalist ontology, *Parallel Processing Letters*, **22** (2012) 1240009 (12 pages), DOI: 10.1142/S0129626412400099 [preprint]
8. L. E. Szabó: Formal Systems as Physical Objects: A Physicalist Account of Mathematical Truth, *International Studies in the Philosophy of Science*, 17 (2003) pp. 117 – 125 (preprint: PDF)

9. T. Kuhn: Scientific Revolutions, in *The Philosophy of Science*, R. Boyd et al. (eds.), MIT Press 1991, pp. 139-157.

Code of course: **BMI-LOTD-206E.05, BMI-LOTD-208E.6, BMI-LOTD17-208E**

Title of course: **Space and Time in Physics and Metaphysics**

Lecturer: **László E. Szabó**

General aim of the course:

Web site: http://phil.elte.hu/leszabo/spacetime2/2019-2020-2/

Contents:

- Conventionalism, semantic convention, operationalism, constitutive *a priori*
- Absolute vs. relative conceptions and objectivity
- Early 20th century definitions of distance and time - Lorentz vs. Einstein
- The proper understanding of the relativity principle - the lesson from Gallileo
- Reconstruction of the Lorentzian and the Einsteinan theories
- Problems with the standard definitions of distance and time - logical and operational circularities
- The precise empirical definitions of basic spatio-temporal conceptions
- Relativity to what?
- Spacetime, determinism, objective becoming
- Spacetime and existence: presentism vs. eternalism, endurance vs. perdurance
- Spacetime and causality
- Spacetime and irreversibility
- Why just time?

Grading criteria, specific requirements:

Oral exam from the material of the lectures. Video records and the slides of the lectures will be available.

Suggested readings:

- L. E. Szabó: Empirical Foundation of Space and Time, in M. Suárez, M. Dorato and M. Rédei (eds.), *EPSA07: Launch of the European Philosophy of Science Association*, Springer 2009. [PDF]
- J. M. E. McTaggart: The Unreality of Time, in: *The Philosophy of Time* (Oxford Readings in Philosophy), R. Le Poidevin, M. MacBeath (eds.), Oxford University Press, 1993. (Eredeti mű: The Nature of Existence, 33. fejezet, Cambridge University Press, Cambridge 1927.)
- H. Reichenbach: *The Theory of Relativity and A Priori Knowledge*, University of California Press, Berkeley and Los Angeles, 1965.
- L. E. Szabó: On the meaning of Lorentz covariance, *Foundations of Physics Letters* **17** (2004) pp. 479 - 496 [preprint: PDF]
- L.E. Szabó: *A nyitott jövő problémája - véletlen, kauzalitás és determinizmus a fizikában* (*The Problem of Open Future - chance, causality, and determinism in physics*), Typotex Kiadó, Budapest 2002 (The manuscript of the English edition will be available for the students in PDF form.)
- H. Reichenbach: *The philosophy of space and time*, Dover Publications, New York, 1958.
- M. Friedman: *Foundations of Space-Time Theories -- Relativistic Physics and Philosophy of Science*, Princeton University Press, Princeton, 1983.
- J. S. Bell: How to teach special relativity, in *Speakable and unspeakable in quantum mechanics*, Cambridge University Press, 1987.
- A. Einstein, Relativity: The Special and General Theory
- A. Einstein: *A speciális és általános relativitás elmélete*, Kossuth, 1993.

- L. E. Szabó: Lorentzian theories vs. Einsteinian special relativity -- a logico-empiricist reconstruction, in A. Maté, M. Rédei and F. Stadler (eds.), *Vienna Circle and Hungary -- Veröffentlichungen des Instituts Wiener Kreis*, Springer 2011. [PDF]
- L. E. Szabó: Does special relativity theory tell us anything new about space and time? [PDF] (Prolog)

Code of course: **BMI-LOTD-328E.04**

Title of course: **Universal Algebra**

Lecturer: **Zalán Gyenis**

General aim of the course:
This is an introduction to universal algebra for logicians.

Content of the course:
The course covers basic definitions and theorem of universal algebra, such as lattices, congruences, homomorphism theorems, product, quotient, subalgebra, terms, free algebras, identities, Birkhoff's theorems, logical applications: Boolean algebras, discriminator varieties, connections with category theory.

Grading criteria, specific requirements:
Grading is based on homeworks (70%) and a final exam (30%).
Prerequisites: Basic algebra, Set theory, Introductory logic (first order logic)

Required reading:
- Burris-Sankappanavar: Universal algebra, GTM, Springer, 2001
- G. Gratzer: Universal algebra, 2nd edition, Springer, 2008

Suggested further reading:
- J. Jezek: Universal algebra, lecture notes, 2008

Code of course: **BMI-LOTD-329E.01**

Title of course: **Advanced modal logic**

Lecturer: **Zalán Gyenis**

General aim of the course:
The main aim of the course is to discuss advanced topics and papers on modal logic.

Content of the course:
The course includes various topics based on the interests of the students. Sample topics are computability and complexity problems, Lindström-type theorems in modal logic, the algebraization process and its connections with computability, etc.

Grading criteria, specific requirements:
Grading is based on homeworks (70%) and a final exam (30%).
Prerequisites: Modal logic, Set theory, Computability theory, Basic algebra

Required reading:
- Chagrov, M. Zakharyaschev: Modal logic, Clarendon Press, Oxford, 1997
- Blackburn, P., Rijke, M., & Venema, Y. (2001). *Modal Logic* (Cambridge Tracts in Theoretical Computer Science). Cambridge: Cambridge University Press.

Suggested further reading: Various papers selected during the semester.

Code of course: **BMI-LOTD-414E.03**

Title of course: **Formal approaches to Wittgenstein's philosophy**

Lecturer: **Péter Mekis**

General aim of the course:
The course attempts at interpreting key concepts and arguments in Wittgenstein's early philosophy with the toolset of modern formal logic, and whenever possible, providing a partial formal reconstruction of Wittgenstein's work.

Content of the course:
We will read and discuss the Tractatus.

Grading criteria, specific requirements:
Grades will be based on class performance.

Required reading:
Wittgenstein, *Tractatus logico-philosophicus*. Pears-McGuinness Translation.

Code of course: **BMI-LOTD17-108E, BMI-LOTD17-210E**

Title of course: **Workshop Seminar in Logic and Theory of Science (LaPoM)**

Lecturer: **Zsófia Zvolenszky**

The weakly seminar is held on Fridays (16PM, Room 226). It is open to everyone, including students, visitors, and faculty members from all departments and institutes. Erasmus and Ph. D. students can take it as a regular course for credit (code: P/FIL/LOG-113).
The seminar's program, the suggested readings, and other informations are distributed via the mailing list **LaPoM** and are also available from the **LaPoM Archives**.

Code of course: **BMI-LOTD-308E.03**

Title of course: **Introduction to non-classical logics**

Lecturer: **William Brown**

Content of the course:
There are different ways to define what classical logic is, however by classical logic most logicians mean propositional logic and first-order logic. Non-classical logics are all the other logical systems (except the second and higher-order extensions of classical first-order logic).
We will discuss more precisely the definitions of classical and non-classical logic at the beginning of the course.
Non-classical logics can be obtained in a variety of ways, for instance by various extensions and modifications on classical logic. New logical constants can be added (for example we can add a modal operators such as necessity and obtain a modal logic), more than 2 truth values can be allowed (and get many-valued logic), various laws of classical logic can be rejected (excluded middle, explosion principle, double negation, etc.) to obtain new systems and family of systems, etc. Unsurprisingly, non-classical logic is a very large class of logics. We will study various extensions and modifications of classical logic, and see what family of (non-classical) logics we thus obtain (and how those families can be defined and classified). Within each of these families we will study various specific logical systems.
Some families of logics we will study throughout the semester include: modal logics, many-valued logics, intuitionistic logics, conditional logics, paraconsistent logics, relevant logics, etc.

Grading criteria, specific requirements:
Oral exam or presentation at the end of the semester

For the oral exam: Understanding of the material covered in class. - Presentation: Elaboration and presentation of a small original research work related to the course.

Literature:

- Priest, G., An Introduction to Non-Classical Logic . Cambridge University Press, 2nd Edition, 2008.
- Gabbay, Handbook of Philosophical Logic , Springer, 2nd Edition. (various chapters across several volumes, the relevant ones will be mentioned during the classes)
- Beal, J.C., Frassen, van B.C., Possibilities and Paradox: An Introduction to modal and manyvalued logic . Oxford University Press, 2003.

Code of course: **BMI-LOTD-327E**

Title of course: **Algebraic Logic 2**

Lecturer: **Ildikó Sain**

Aim of course:

We investigate distinguished connetcions between logical properties and algebraic ones.

Contents:

Checking the validity of certain distinguished basic logical properties (compositionality, filter property, substitution properties) in some concrete logical systems.

Hilbert type inference system, versions of its completeness and soundness. Algebraic characterization of those properties. Deduction theorem.

Compactness and its variants, their interconnections. Algebraic characterization of compactness.

Interpolation property, definability properties. Algebraic characterizations of them.

Exam:

There will be tests during the semester and an oral exam in the end.

For good result, you must visit classes.

References:

Andréka-Németi-Sain manuscript, Andréka-Németi-Sain chapter in Handbook of Phylosophical Logic vol. II.