LOGIC & PHILOSOPHY

Logic offerings at California State University San Bernardino have depth and breadth rare at undergraduate institutions in the United States. Courses range from the introductory level to topics including set theory, soundness and adequacy of the predicate calculus, and the incompleteness of arithmetic with corresponding results for computability. This material is foundational to disciplines as diverse as philosophy, mathematics and computer science. Not only that, but it comes recommended by the instructors (and Plato) as "good for the soul."

The minor in philosophical logic presents an opportunity to develop a robust background in logic that would position the student not only for application of logical notions in disciplines such as philosophy, mathematics and computer science, but also for further logical studies, both at the graduate level, and as an independent learner. The logic minor consists of Phil 200 (sentential logic), Phil 300 (predicate logic) and four additional courses that go beyond that required of all CSUSB Philosophy majors. As described below, most courses are offered at least on an alternate year schedule.

MINOR IN PHILOSOPHICAL LOGIC (24 units)

1. Core requirements: 16 units as follows

Phil 200	Critical Thinking Through Symbolic Logic
Phil 300	Predicate Logic
Phil 381/383	Philosophy of Logic, or Philosophy of Mathematics
Phil 400a/400b	Advanced Issues: Metalogic, or Advanced Issues: Incompleteness and Computability

2. Elective requirements: 8 units chosen from

Phil 306	Inductive Logic
Phil 308	Alternative Logics
Phil 381	Philosophy of Logic
Phil 383	Philosophy of Mathematics
Phil 400	Advanced Issues in Logic (may be repeated as topics change)

PHIL 200 – CRITICAL THINKING THROUGH SYMBOLIC LOGIC *(every Quarter).* Phil 200 is a first course in critical thinking. In this case, critical thinking is introduced through formal logic. We spend some time introducing the basic notions of logical validity and soundness. Then we introduce the basic elements of formal logic by introducing a formal language and corresponding accounts of truth and proof.

The text is excerpted from a longer manuscript, Symbolic Logic: An Accessible Introduction to Serious Mathematical Logic by Prof. Roy; we cover material from the first parts of chapters 1, 2, 4, 5, and 6.

PHIL 300 – PREDICATE LOGIC *(every Winter)*. Philosophy 300 introduces the standard predicate calculus. We push beyond treatment of the logical operators, 'if . . . then', 'if and only if', 'and', 'not', 'or', and move on to the quantifiers 'all' and 'some'. This material greatly expands the power of our symbolic logic, including to general mathematical reasoning.

Phil 300 has Phil 200 (or consent of instructor) as prerequisite. If it's been some time since you had Phil 200, you might check out the material from chapter 1, and the first parts of chapters 2, 4, 5 and 6 in the manuscript, Symbolic Logic: An Accessible Introduction to Serious Mathematical Logic. In this course, we complete chapters 2, 4, 5 and 6 along with chapter 7.

PHIL 306 – INDUCTIVE LOGIC *(Fall 2018)*. Most of the reasoning we do throughout our lives is inductive reasoning. Reasoning in the sciences is inductive as well. Nevertheless, much about the foundations of these inferences remains philosophically controversial. In this course we will examine inductive logic and its attendant philosophical problems. We will begin with the most fundamental of these problems: Hume's problem of the justification of inductive inferences. We will examine a number of purported solutions to this problem, and along the way discover additional problems.

In addition to wrestling with the problem of induction we will also study the probability calculus, since probability plays a central role in inductive reasoning, and learn some practical applications of the probability calculus. But the study of probability brings up its own philosophical questions. Just what are probabilities? When we say that an event is probable, are we talking about an objective state of affairs or are we talking about our own lack of certainty? Which interpretation of the probability calculus is most plausible? Prerequisite: Phil 200 or consent of instructor.

PHIL 308 – ALTERNATIVE LOGICS *(Fall 2017)*. Alternative logics have multiple motivations. Just as predicate logic extends sentential logic to include *all* and *some*, so one may desire further extensions to, say, *necessity* and *possibility*. Further, there may seem to be fundamental difficulties for the classical approach. So, perhaps you were initially shocked (!) to discover that in classical logic anything follows from a contradiction. In this course, we consider logics alternative to the classical approach, with attention to issues of both sorts. Systems to be considered combine, in different ways, semantics based on *possible worlds,* and semantics allowing truth values beyond T and F (e.g., *neither* and even *both*); these include modal logics, conditional logics, and relevant logics. In one way or another, each has important philosophical applications, and each is itself a subject of philosophical debate.

The main text is Priest, *An Introduction to Non-Classical Logic: From If to Is* (2nd ed). The primary treatment of the logics is sentential, so the only prerequisite is Phil 200.

381 – PHILOSOPHY OF LOGIC *(Fall 2016)*. The course examines the philosophical significance of sentential and predicate logic (the logics taught in Phil 200 and Phil 300). These are *formal* logics: they consist of precisely defined formal objects which relate to one another in precisely defined formal ways. What do these formal objects and relations tell us about natural language sentences and arguments? This is the central question of the course, explored with respect to a variety of specific topics. These topics include: by what principle or principles are expressions like 'and' distinguished as logical? is logical consequence to be characterized in terms of possible interpretations, or in terms of basic inference rules? is there one universal true logic or is there a variety of equally adequate logics?

In addition to the standard prerequisites for upper division philosophy, this course has Phil 200 and Math 110 (or consent of instructor) as prerequisites.

PHIL 383 – PHILOSOPHY OF MATHEMATICS *(Winter 2018).* You have, presumably, been introduced to mathematics at some level, where basic mathematical truths are taken to be obvious. But there is something fundamentally mysterious about mathematical claims which seem to be about *numbers* located neither in space nor in time. The mystery is compounded as we broaden our view to higher mathematics, where claims not only seem to concern non-spatial and non-temporal objects, but *infinite* collections of such objects as well. We shall examine the philosophical accounts developed to remove these mysteries and clarify the grounds for mathematical truth. The accounts studied will be those given by both historical and contemporary thinkers, and include logicism, formalism, intuitionism, platonism, fictionalism and structuralism. Ours is not a course *in* logic or mathematics! Rather we shall think *about* the grounds of this discipline, and so about the very grounds of what may seem itself fundamental to science and thought more generally.

Primary texts are Shapiro, *Thinking About Mathematics,* and Benacerraf & Putnam eds., *Philosophy of Mathematics: Selected Readings* 2nd ed. In addition to the standard prerequisites for upper division philosophy, this course has Phil 200 and Math 110 (or consent of instructor) as prerequisites.

PHIL 400a – ADVANCED ISSUES IN LOGIC / METALOGIC *(Spring 2018).* This section of Phil 400 is a first course in classical metalogic. You have, presumably, already learned to use the classical symbolic logic. In this course we think rigorously about the logic you have learned to use. There is doing of logic; in particular, axiomatic systems are introduced and used. But the main weight is on what the logic does and how it works. Central results for 400 are *soundness* and *adequacy* of the full predicate calculus: we demonstrate that an argument is provable in our derivation systems iff it is semantically valid.

The prerequisite is Phil 300 (or consent of instructor). If it's been some time since you had Phil 300, you may want to review material from chapters 1, 2, 4, 5, 6 and 7 of Symbolic Logic: An Accessible Introduction to Serious Mathematical Logic. In Phil 400a, we begin with chapter 3, and then complete Parts II and III of the text.

PHIL 400b – ADVANCED ISSUES IN LOGIC / INCOMPLETENESS AND COMPUTABILITY *(Spring 2017).* Given the ubiquity of proof in mathematics, it is natural to suppose there are derivations to demonstrate any arithmetical truth. Perhaps you have worked derivations in systems such as Robinson or Peano Arithmetic (this is not a prerequisite). It is natural to think that some such system would be adequate to any truths of arithmetic. But Gödel shows *this is not so,* and we develop Gödel's famous *incompleteness* results: It is not *possible* for a consistent 'nicely' specified deductive theory to have as consequences all the truths of arithmetic. Neither is it possible for such a theory including at least Peano Arithmetic to demonstrate its own consistency. We develop these limiting results for the power of derivations, along with corresponding results limiting the reach of computing devices.

The prerequisite is Phil 300 (or consent of instructor). If it's been some time since you had Phil 300, you may want to review material from chapters 1, 2, 4, 5, 6 and 7 of Symbolic Logic: An Accessible Introduction to Serious Mathematical Logic. In Phil 400b, we begin with chapter 3, and then turn to Parts II and IV of the text. Smith, *An Introduction to Gödel's Theorems* is highly recommended.

PHIL 400c – ADVANCED ISSUES IN LOGIC / SET THEORY *(Spring 2019).* In everyday contexts we use the notion of a set often to talk about things like books on shelves and spoons in drawers. Set theory extends in abstractness and scope far beyond these contexts, giving us the means to talk intelligibly about the infinite, furnish a foundation for mathematics, and conduct investigations in metaphysics. We first look at the basic results of the subject from a perspective known as `naïve set theory.' The perspective is known as naïve because it does not provide explicit safeguards against the famous Russell paradox. After going over the paradox and challenge it poses to naïve set theory, we examine the principles of the non-naïve and firmly established conception of sets known as the 'iterative conception.' The prerequisite is Phil 300 or consent of instructor.