Symbolic Logic

Spring 20XX

It is a sadly limited view of the power of mind in man to suppose that only truth employs or
pleasures it. It appears … that thought itself proceeds by quantities and extensions, yet one may
contemplate the most purely abstract and most purely quantitative system for the values of the
system’s sake, and so far as this is done, and is the end of such pure systems, they, and the
opposite pole of art, have the same appreciative aim, and are in value much akin; for creative
thought and creative imagination are not so much stirred on by truth in any synthetic sense as by
sublimity – a vision of absolute organization.

– William H. Gass

Instructor: Whit Schonbein
Meeting times: MWF, 10-11

Hill.

A Brief Overview

The topic of this course is symbolic logic. In particular, we will look at two
extremely influential and useful systems of symbolic logic: ‘sentential logic’ and
‘predicate logic’. During the course of the semester, we will cover material from
the following chapters, in the following order, time permitting:

- Chapter 1: Basic Notions of Logic
- Chapter 2: Sentential Logic: Syntax
- Chapter 3: Sentential Logic: Semantics
- Chapter 5: Sentential Logic: Derivations
- Chapter 7: Predicate Logic: Syntax
- Chapter 8: Predicate Logic: Semantics
- Chapter 10: Predicate Logic: Derivations
- Chapters 6 & 11: Metatheory

Statement on General Education

This class fulfills a general education requirement in mathematical reasoning and
analysis. The purpose of our general education requirements is to introduce you
to the different perspectives taken by different academic disciplines in the pursuit
of different forms of knowledge. Understanding these perspectives and forms of
knowledge is crucial for appreciating the range of human experience, and for
acting as an informed citizen.

In a general education class in mathematics, you will learn to reason about the
properties of and the relations between purely mathematical objects, and about
how these theoretical objects can be used to model and understand real-world
phenomena. In this course in symbolic logic, we learn how arguments in ordinary
languages can be translated into mathematical or symbolic form, and how the
reasoning of those arguments can be assessed with mathematically rigorous standards of proof.

**Homework**

Given the nature of the subject, this is a homework-intensive class.

For each class meeting (with some exceptions) there will be a homework assignment due. Homework is due at the beginning of each class period, and late homework will not be accepted. Homework must be handed in as a hard-copy; no email submissions will be accepted.

For each assignment, answers will be posted to the website after the due-date for that assignment. There are approximately 30 homework assignments for the semester. At the end of the semester, for each student, the assignments with the three lowest scores will be dropped, and will not figure into the final homework score. Note that midterm grades will not reflect this.

If you have a question concerning the grading of a homework assignment, please see me within two weeks of the date on which the homework was returned. After this time, I cannot guarantee that any scores will be changed.

A note on the text: Each chapter is divided into sections 1, 2, …, etc. Exercises are located at the end of each section. The text indicates the exercise section by appending an ‘E’ to the section number. For example, exercises from chapter 2, section 7, are referred to by ‘2.7E’. Within each set of exercises, there may be multiple groups of problems, with each group numbered 1, 2, … etc. For example, section 1.6E has 6 groups of problems. We can refer to a group by providing the section number along with the group number. For example, ‘1.6E.4’ refers to the fourth group of problems in the exercises for chapter 1, section 6. Homework assignments make use of this convention. For example, ‘1.6E.4: Starred problems’, means ‘do each problem marked with an asterisk in group 4 of the exercises in chapter 1, section 6’.

**Homework Strategies**

In addition to specific strategies discussed in class, two additional recommendations are as follows. First, assignments utilize only a fraction of the available exercises for each section. You are encouraged to practice by doing additional problems; answers to all un-starred exercises are available on the CD-ROM included with the text.

Second, you are encouraged to work in groups on homework assignments. The utility of working in groups cannot be overemphasized. If you do work in a group for a given assignment, you may hand in the assignment as a group, i.e., as a single document, provided all the members of the group are clearly indicated on the front page.
Meetings
During the semester, there will be two mandatory 15-minute informal meetings with the instructor. The purpose of these meetings is to (i) give the instructor an opportunity to provide some feedback concerning your work, and (ii) give each student an opportunity to voice their opinions on the workings of the class, offer suggestions, and so forth. Sign-up sheets will be made available in class.

Exams
There will be four exams: #1 covers chapters 1-3, #2 covers chapter 5, #3 covers chapters 7 and 8, and #4 (the final exam) covers chapter 10 (and any material from chapters 6 and 11, should we make it that far).

Some things to note: First, all tests will be in-class, except for the last test, which will be taken during finals week at the officially scheduled time. Second, for purposes of the final grade, each test is equally weighted. Third, no test will be comprehensive, except insofar as later material builds upon our knowledge of earlier material. Be aware that, in this course, later material always builds on earlier material.

Grading
Each student’s final grade is based on (i) the tests, and (ii) homework. The number of tests depends on the amount of material we are able to cover. Each test factors equally in determining the final grade, and the overall homework score (see above) has the same weight as a test.

Schedule (based on MWF schedule)
Includes homework assignments for the first four weeks (approximately).

1. Introduction – Overview of the course

A. Basic Concepts of Formal Logic

2. 1.3-1.5: Deductive Arguments and Validity
   Homework #1: 1.4E.1: Starred exercises (Due at the next meeting)

3. 1.6-1.7: Consistency, Equivalence, and Validity (Revisited)
   Homework #2: 1.6E.2: d, f, j; 1.6E.4: b, h, l; 1.6E.6: b, d, f, n (Due at the next meeting; the same note applies to each assignment)

B. Sentential (Propositional) Logic: Symbolization and Semantics

4. 2.1: Sentential Symbolization 1
   Homework #3: 2.1E.1: b, f, l, n; 2.1E.5: d, f, n, p; 2.1E.7: b, d
5. 2.2-2.3: Sentential Symbolization 2
   Homework #4: 2.2E.1: b, d, f; 2.2E.3: b, d, f, h; 2.2E.5: b, d

6. 2.4: The Formal Syntax of Sentential Logic
   Homework #5: 2.4E.1: b, d, f; 2.4E.3: b, d, f, h 2.4E.5: b, d, j

7. 3.1: The Semantics of Sentential Logic I (Truth Tables)
   Homework #6: 2.4E.4: b, d, f; 3.1E.2: b, d, f, h 3.1E.3: b, d, j

8. 3.2 & 3.3: Semantics II (Tautologies etc.)
   Homework #7: 3.2E.1: b, d, f, h; 3.2E.4: b, d, f; 3.3E.1: b, d, f

9. 3.4 & 3.5: Consistency and Entailment
   Homework #8: 3.4E.1: b, d, f; 3.4E.2: b, d, f; 3.5E.1: b, d, h, j

10. 3.6: Truth-functional properties and consistency
    Homework #9: 3.5E.2: b, d; 3.6E.1: b; 3.6E.2: b

11. Review

12. Test #1 (covers chapters 1-3; in class; closed book)

C. Sentential Logic: Derivations

13. 5.1: Derivations in Sentential Logic 1 (R, &I, &E\textsuperscript{1}, →I (CP), →E (MP))
    Homework #10: 5.1.1E: b, d; 5.1.2E: b, d

14. 5.1: Derivations in Sentential Logic 2 (~I, ~E (RAA), vI, vE (DS), ≡I, ≡E)

15. 5.2: Derivations 2 (examples and discussion)

16. 5.2-5.4: Derivations 3 (formal definition of validity, further examples and discussion)

17. 5.4: Derivations 4 (further strategies)

18. 5.5: Extended Rules (MT, HS, DS, DN, Rules of Replacement)

19. 5.5: Derivations using Extended Rules

20. 5.5: More Derivations using Extended Rules

21. Review

\textsuperscript{1} ‘I’ stands for ‘Introduction’ and ‘E’ stands for ‘Elimination’. Some textbooks refer to these rules as ‘In’ and ‘Out’ rules, respectively, and accordingly use ‘I’ and ‘O’ rather than ‘I’ and ‘E’.
22. Test #2 (covers chapter 5; in class; closed book)

D. Predicate Logic: Symbolization and Semantics

23. 7.1-7.2: Predicate Logic (Motivation, Predicates, Constants)

24. 7.3: Predicate Logic – Basic Symbolization

25. 7.4: Quantifiers

26. 7.5: The Formal Syntax of Predicate Logic

27. 7.6: Predicate Symbolization 1 (A, E, I, O sentences)

28. 7.7: Predicate Symbolization 2 (More complicated symbolization)

29. 7.8: Predicate Symbolization 3 (Quantifier scope)²

30. Discussion of Symbolization Homeworks

31. 8.1-8.4: The Semantics of Predicate Logic (Interpretations, definitions of Equivalence, Entailment, Consistency, etc.)

32. Review

33. Test #3

E. Predicate Logic: Derivations

34. 10.1: Derivations in Predicate Logic 1 (∀E, ∃I)

35. 10.1: Derivations in Predicate Logic 2 (∀I, ∃E)

36. 10.2: Derivations in Predicate Logic 2 (Strategies)

37. 10.3: Concepts: Validity, Equivalence, etc.

38. 10.4: Derivations in Predicate Logic 4 (Intermediate Proofs)

39. 10.5: Derivations using Extended Rules (QN, Rules of Replacement, etc.)

40. 10.5: More Derivations using Extended Rules

² Section 7.9 covers identity, and this may be included in future versions of this syllabus.
41. Discussion of Derivations

42. Last day of class – Review

43. Final Exam (see exam schedule for time)
Proposal for a New Course

NOTE: (1) All gray text boxes must be completed (even if you just put N/A into them), otherwise the committee must consider the form incomplete.
NOTE: (2) If the new course is to be accepted as fulfilling General Education requirements, a separate approval must be done through the General Education Committee.

Contact person Larry Krasnoff  Email address krasnoff@cofc.edu Phone 3-4987

1. Department: Philosophy

2. Course number and title: PHIL 120: Symbolic Logic
   Number of Credits: 3  Total hrs/week: 3
   Lecture: ☑  Lab: ☐  Recitation: ☐  Seminar: ☐

   For Independent study courses:
   Research: ☐  Field experience: ☐
   Clinical Practice: ☐  Internship: ☐
   Practicum: ☐  Independent Course Work: ☐

3. Semester and year when course will first be offered:
   Spring 2011

4. Catalog Description (please limit to 50 words):
   An introduction to the formal methods of deductive logic, including sentential and predicate logic.

5. CIP Code: 38.0102 (This code must be determined for new courses. The codes can be found at http://nces.ed.gov/ipeds/cipcode/. If you are not sure what code to use, please consult with the Institutional Research).

6. Check if appropriate: ☐
   This course will be cross listed with:
   Rationale for cross listing:
   Please attach letters of support from the chairs of each department indicating that the department has discussed the proposal and supports it.

7. a) Could another department or program also be a logical originator of this course (i.e. History of American Education could originate in both the Teacher Education and the History departments)? If yes, what department/program? Please contact the department chair/program director and request a note or email that they are aware of the proposed new course and include that note with the proposal.
   Mathematics: See the correspondence from the Department of Mathematics, with the accompanying proposal to change the General Education requirement in mathematics, which expresses their support for the proposal and for this new course.
Proposal for a New Course

b) Please explain overlap with any existing courses.
This course overlaps with the current PHIL 215 and part of the current PHIL 216.
We are asking that those courses be deleted and replaced with this single-
semester symbolic logic offering.

We also want to explain our reasons for moving our symbolic logic offering to the
100 level. In our view, the 200-level numbering of the current courses is a
historical accident that predates the faculty now offering the course; none of us
can understand why logic was ever at the 200 level. Though 215 is now required
for both the major and the minor, it is also open to and widely taken by non-
majors without any other work in philosophy. We thus see the new course, and
have always seen the current courses, as more closely analogous to our other
100 level courses, which do not necessarily assume that students have taken or
will take other courses in philosophy.

8. Prerequisites (or other restrictions):
   None

9. Rationale/justification for course (consider the following issues):
   a) What are the goals and objectives of the course?
      To allow students to better understand and evaluate the arguments they
      encounter in all forms of discourse, by translating them into a formal or symbolic
      language, and evaluating their logical validity through mathematically rigorous
      standards of proof.

   b) How does the course support the mission statement of the department and the organizing
      principles of the major?
      Though it is also taught in mathematics departments, logic has traditionally been
      a branch of Western philosophy, going back to Aristotle. Logical inference and
      logical necessity have long been understood as essential to the nature of rational
      justification, which has been a special concern of Western philosophy. Virtually
      every philosophy department offers courses in symbolic logic, and most require
      their majors and minors to study it, as we do here.

10. a) For courses in the major, how does the course enhance the beginning, middle, or end of
     the major?
     This course provides majors with an essential tool for other work in the major.
     Philosophy majors need to be comfortable with understanding and evaluating the
     logical structure of arguments, and with understanding material in which
     arguments have been expressed in symbolic form. Students typically take logic
     early in their careers as majors.

     b) For courses used by non-majors, how does the course support the liberal arts tradition
Proposal for a New Course

including linkages with other disciplines:
This course offers non-majors a chance to study a branch of mathematical reasoning that requires no prerequisite. Symbolic logic has been long been an attractive option for students seeking to complete their General Education requirement in mathematics.

11. Method of teaching:
   Lecture and discussion of problem sets.

12. a) Address potential enrollment pattern shifts in the department or college-wide related to the offering of this course:
   No major shifts expected. We currently offer two sections of PHIL 215 and one section of PHIL 216 every semester. Majors and minors are required to take only 215, but Gen Ed credit is currently given only for students who take both 215 and 216. Once this restriction is eliminated, we will lose the "captive audience" in 216, but we may be able to attract more Gen Ed students who were not ready to commit to two courses in logic. Depending on the popularity of the new course, we will offer 2-4 sections of the new course per semester.

   b) Address potential shifts in staffing of the department as it relates to the offering of this course:
   None expected. The same faculty who currently teach 215 and 216 are equally qualified and willing to teach the new class.

   c) Frequency of offering:
      each fall: [ ] each spring: [ ]
      every two years: [ ] every three years: [ ]
      other [ ](Explain): each semester

13. Requirements for additional resources made necessary by this course:
   a) Staff:
      None.

   b) Budget:
      None.

   c) Library:
      None.

14. Is this course to be added to the Degree Requirements of a Major, Minor, Concentration or List of Approved Electives?
   a) [ ] yes  [ ] no

   b) If yes, complete the Change Degree Requirements form(s) and list the name(s) of the major,
Proposal for a New Course

minor, concentration and/or list of approved electives here:
Major in philosophy; minor in philosophy.

15. Paste syllabus, reading lists, or any additional documentation that can help the committee evaluate this proposal (a syllabus is mandatory).
Syllabus is attached.
Proposal for a New Course

16. Signature of Department Chair or Program Director:________________________________________________________

Date: ____________________________

17. Signature of Dean of School:

________________________________________________________

Date: ____________________________

18. Signature of Provost:

________________________________________________________

Date: ____________________________

19. Signature of Curriculum Committee Chair

________________________________________________________

Date: ____________________________

20. Signature of Faculty Senate Secretary:

________________________________________________________

Date Approved by Senate: ____________________________

Completed form should be sent by the Faculty Senate Secretary to the Registrar. After implementation, information concerning the passed course and program changes will be provided by the Registrar to all faculty and staff on campus.