

CLASSES: Wednesday 19:00-21:00 in KTH B102  
 INSTRUCTOR: Richard T. W. Arthur

JANUARY-APRIL 2017  
 OFFICE: UH 305; ext. 23470

### COURSE DESCRIPTION

**Although this course presupposes a high level of competence in logic, it develops into something very different from a first course in the foundations of modern logic. Thus on the one side, various alternative logics have been developed that build on those foundations. But on the other, investigations of those foundations have raised some profound and fascinating questions. The following quotation from Nietzsche puts it well: “When the enquirer, having pushed to the [periphery of science], realizes how logic in that place curls about itself and bites its own tail, he is struck with a new type of perception: a tragic perception which requires, to make it tolerable, the remedy of art.” This could serve as the motif for this course: logic biting its own tail. It is implicit in paradoxes such as Zeno’s paradoxes of motion and plurality, which Lewis Carroll extends to *modus ponens*. But the theme of logic curling about itself is unfolded with a vengeance in developments in modern mathematical logic, particularly with the theory of recursive functions, and the discoveries of Gödel’s Theorem and Skolem’s Paradox. These have profound implications for subjects as diverse as the theory of knowledge and the nature of artificial intelligence, and are imaginatively and artistically explored in Hofstadter’s *Gödel, Escher, Bach*—as are their implications for artificial intelligence, their connections with Escher’s woodcuts, Bach’s fugues, molecular genetics, Zen Buddhism and a million other fascinating subjects. Meanwhile *Logical Options* will serve as our guide for alternative systems of logic.**

### REQUIRED TEXTS

1. *Gödel, Escher, Bach: An Eternal Golden Braid*, Douglas R. HOFSTADTER, Vintage Books, N.Y., 1979.
2. *Logical Options: An Introduction to Classical and Alternative Logics*, John L. BELL, David DEVIDI and Graham SOLOMON., Broadview Press, 2001.

### Course Requirements

**Homework.** During the course, you will be assigned a number of homework problems, solutions to be handed in at the beginning of class.....  
 ..... (30%)

**Leading class discussion** on the readings assigned for one of the classes.....  
 ....(10%)

**Alternative Logics assignment.** You will investigate an alternative logic of your own choosing (e.g. Contextual Logic, Modal Logic, 3-valued Logic, Intuitionistic Logic, Fuzzy Logic, Quantum Logic, Free Logics), and construct a report (~2000-3000 words) on what motivated it, what particular problems or difficulties it resolves, and then give your own evaluation of its prospects of success.....(20%)

***Final Essay* (~6000 words) on a topic related to the Hofstadter readings.....  
.....(40%)**

#### **COURSE WEBSITE**

**I will be using Avenue to Learn (<http://avenue.mcmaster.ca/>) and a dedicated website (<http://www.humanities.mcmaster.ca/~rarthur/6XX3/>) to post regular announcements and information about the course, lists of supplementary readings, additional resources, and information and advice about assessment (including essay questions). You are expected to check in every couple of days.**

**SYLLABUS (provisional; updates on the course webpage)**

**Week 1 Jan 4 *introduction***

Reading: [Read ahead if you have the syllabus!]

**Week 2 Jan 11 *Zeno and Carroll***

Reading: GEB, Intro, chs. 1-2 (pp. 3-60); BDS 1.1-1.22 (pp. 1-13)

Homework: Solve the “MU puzzle” (GEB, p. 3-63);

**Week 3 Jan 18 *meaning, form and self-reference***

Reading: GEB, chs. 3-4 (pp. 61-102); BDS 1.23-1.25 (pp. 14-21); Homework:  
TBD

**Week 4 Jan 25 *consistency, completeness, recursion***

Reading: GEB, chs. 5-6 (pp. 103-176); BDS 1.3-1.4 (pp. 21-34); Homework:  
TBD

Homework: Solve the “MU puzzle” (GEB, p. 3-63);

**Week 5 Feb 1 *the propositional calculus***

Reading: GEB, ch. 7 (pp. 177-197); BDS 1.5 (pp. 34-53); Homework: TBD

**Week 6 Feb 8 *predicate calculus and number theory***

Reading: GEB, ch. 8 (pp. 199-230); BDS 2.1-2.5 (pp. 54-87); Homework: TBD

**Week 7 Feb 15 *Gödel's Incompleteness Theorem (1)***

Reading: GEB, ch. 9 (pp. 231-272); BDS 2.6-2.7 (pp. 87-101); Homework: TBD

**———— Feb 20-25 Midterm Recess —————**

**Week 7 Mar 1 *on levels, computers and brains***

Reading: GEB, chs. 10-11 (pp. 275-365); BDS 2.6-2.7 (pp. 87-101); Homework:  
TBD

**Week 8 Mar 8 *on minds, thoughts, and recursive functions***

Reading: GEB, chs. 12-13 (pp. 366-430); BDS 2.6-2.7 (pp. 87-101); Homework:  
TBD

**Week 9 Mar 15 *Gödel's Incompleteness Theorem (2)***

Reading: GEB, chs. 14-15 (pp. 431-479); BDS 2.6-2.7 (pp. 87-101); Homework:  
TBD

**Week 10 Mar 22 *self-ref, DNA and life***

Reading: GEB, ch. 16 (pp. 480-548); BDS 2.6-2.7 (pp. 87-101); Homework: TBD

**Week 11 Mar 29 *Church, Turing, Tarski etc.***

**Reading: GEB, ch. 17 (pp. 549-585); BDS 2.6-2.7 (pp. 87-101); Homework: TBD**

**Week 12 Apr 5 *strange loops***

**Reading: GEB, ch. 20 (pp. 681-742); BDS 2.6-2.7 (pp. 87-101); Homework: TBD**

**—a more detailed syllabus with all the homework assignments will gradually unfold on the course website.**