

## Lassonde School of Engineering

Dept. of EECS

Professor G. Tournakis

MATH1090 A. Problem Set No 4

**Posted:** Nov. 24, 2020

**Due: Dec. 8, 2020; by 3:00pm, in eClass, “Assignment #4”**

**Q: How do I submit?**

**A:**

- (1) **Submission must be ONLY ONE file**
- (2) **Accepted File Types: PDF, RTF, MS WORD, ZIP**
- (3) **Deadline is strict, electronically limited.**
- (4) **MAXIMUM file size = 10MB**



It is worth remembering (from the course outline):

The homework must be each individual's own work. While consultations with the instructor, tutor, and among students, are part of the learning process and are encouraged, nevertheless, *at the end of all this consultation* each student will have to produce an individual report rather than a copy (full or partial) of somebody else's report.

**The concept of “late assignments” does not exist in this course.**



In what follows, “give a proof of  $\vdash A$ ” or “show  $\vdash A$ ” means to give an Equational or Hilbert-style proof of  $A$ , unless some other proof style is required (e.g., Resolution).

Annotation is always required!

Do the following problems (5 MARKS/Each).

1. Prove using **soundness** (**Required**):

$$\not\vdash (\forall \mathbf{x})(A \vee B) \rightarrow (\forall \mathbf{x})A \vee (\forall \mathbf{x})B$$

2. Prove using **soundness** (**Required**):

$$(\forall \mathbf{x})A \rightarrow (\forall \mathbf{x})B \not\vdash (\forall \mathbf{x})(A \rightarrow B).$$

3. Use the  $\exists$  elimination technique — **Required** — to show  $\vdash (\exists \mathbf{x})(A \wedge B) \rightarrow (\exists \mathbf{x})(A \rightarrow B)$ .

4. Use the  $\exists$  elimination technique — **Required**; and ping-pong if/where needed — to show  $\vdash (\exists \mathbf{x})(A \equiv \neg A) \equiv \perp$ .

 Do **NOT** use an Equational proof NOR WL for the above Question (0 marks for such solutions).



- 5.

(3 MARKS) Prove  $\vdash (\forall x)(\forall y)x = y \rightarrow (\forall y)y = y$ .

(2 MARKS) Also explain precisely why the above is NOT an instance of **Ax2**.