PHI 324 : Category Theory

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Course Description. This course provides an introduction to category theory. We take the point of view that category theory is not just a theory in mathematics, but also a theory about mathematics. As such, we will emphasize the role of category theory as a new kind of mathematical logic, applicable to a wide range of disciplines. Core topics include functors and natural transformations, limits and adjoints, monads and Kan extensions. Special topics may include: basic topos theory, higher categories and categorical logic.

Prerequisites. A course in logic, algebra, or topology.

Textbook/Readings. The course is based on the textbook

- *Categories for the Working Mathematician*, (2nd ed.) by Saunders Mac Lane.

Mac Lane's textbook is the only required reading for this course and lectures will follow it closely. Some other textbooks you might wish to consult are the following:

- *Category Theory*, (2nd ed.) by Steve Awodey
- *Basic Category Theory* by Tom Leinster
- *Categories in Context* by Emily Riehl

Schedule. There will be biweekly lectures, which will generally follow the progression in Mac Lane's textbook:

Wk 1 : Categories, Functors, Natural Transformations (Ch. I)
Wk 2 : Constructions on Categories (Ch. II)
Wk 3 : Representability & the Yoneda Lemma (Ch. III)
Wk 4 : Limits and Colimits (Ch. III)
Wk 5 : Adjoints & Cartesian Closed Categories (Ch. IV)
Wk 6 : Existence, Preservation and Applications of (Co)limits (Ch. V)
Wk 7 : Adjoint Functor Theorems (Ch. V)
Wk 8 : Monads, Algebras and Monadicity (Ch. VI)
Wk 9 : Monoidal Categories & Coherence Theorems (Ch. VII)
Wk 10 : Ends, Coends & Kan Extensions (Ch. IX)
Wk 11 : Special Topic: Basic Categorical Logic
Wk 12 : Special Topic: Elementary Topos Theory