Department of Mathematics, College of Science, King Saud University

Second Semester: 1441-1442(January, 2020 – May, 2020)

Faculty: Prof. Dr. T M G Ahsanullah

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Course Name: MATH 436: Mathematical Logic (Elective Course) 4 credit hours

Course details

Book: Mathematical Logic: Part I and II: By R. Cori, D. Lascar, translated by D. H. Pelletier, Oxford University Press, London, 2008.

Further Readings:

1. A Course on Mathematical Logic by Shashi Mohan Srivastava, Springer, 2013
2. An Introduction to Mathematical Logic by E. Mendelson, Chapman & Hill, London, 1997
3. Introduction to Mathematical Logic by Michal Walick, World Scientific, 2011

Prerequisite: **Math 131**: Foundations of Mathematics (4 Credit hours)

Content: Basic mathematical logic, methods of proof, basics of set theory, mathematical induction, cartesian product of sets, binary relations, partition of a set, equivalence classes, mappings(functions), equivalence of sets, countable sets, cardinal numbers, binary operations, homomorphism of algebraic systems, groups, rings and fields.

Book: 1. Foundations of Mathematics by Kenneth Kunen, 2007.

2. The Tools of Mathematical Reasoning by Tamara J. Lakins, AMS, Providence, RI, 2016

Math 436(detail-program):

1. **Propositional Calculus (5 Weeks=15 lectures + tutorial sessions)**
   a) Propositional formulas
   b) Proofs in propositional logic and proofs by induction on the set of formulas
   c) The unique decomposition theorem
   d) Semantics: Assignments of truth values and truth tables
   e) Tautologies and logically equivalent formulas
   f) Some tautologies

g) Examples: View Boolean algebras (correct algebraic structures for logic) that can be seen as logically equivalent formulas of the propositional calculus

2. First-order theories (3 Weeks=9 lectures+ tutorial sessions)

a) Introduction: meaning of first-order theories with plenty of examples from various sources such as group theory, theory of rings, field theory, theory of ordered fields, etc.

b) Semantics of first-order languages

c) Structures of first-order languages

3. **Predicate calculus (4 Weeks=12 lectures+ tutorial sessions)**

a) Syntax: First-order languages

b) Terms of the language

c) Formulas of the language

d) Structures

e) Homomorphisms and isomorphisms

f) Consistence of first-order predicate calculus

g) Universal equivalence and semantic consequence

4. Completeness theorem for predicate logic (3 Weeks=9 lectures+ tutorial sessions)

a) Axioms and rules: The deduction rules (modus pones, the rule of generalization)

b) Formal proofs

c) Deduction theorem

d) The completeness theorem (Gödel)

Mark Distribution:

MT 1: 25
MT2: 25
Tutorial: 10
Final: 40