MGF1121 Course Outline

Introduction to Logic..... (3) (P)

Description: This course is a study of both the formal and informal nature of human thought. It includes an examination of informal fallacies, sentential symbolic logic and deductive proofs, categorical propositions, syllogistic arguments and sorites.

General Education Learning Outcome: The primary General Education Learning Outcome (GELO) for this course is Quantitative Reasoning, which is to understand and apply mathematical concepts and reasoning, and analyze and interpret various types of data. The GELO will be assessed through targeted questions on either the comprehensive final or an outside assignment.

Prerequisite: MFG1100, MAT1033, or MAT1034 with a grade of "C" or better, OR the equivalent.

Rationale: In order to function effectively and productively in an increasingly complex democratic society, students must be able to think for themselves to make the best possible decisions in the many and varied situations that will confront them. Knowledge of the basic concepts of logical reasoning, as offered in this course, will give students a firm foundation on which to base their decision-making processes. Students wishing to major in computer science, philosophy, mathematics, engineering and most natural sciences are required to have a working knowledge of symbolic logic and its applications.

Impact Assessment: *Introduction to Logic* provides students with critical insight into the formal nature of human thought. Its relevancy to all academic disciplines is inherent in the very nature of logic itself. The course also applies toward the General Education mathematics requirement area B for an Associate of Arts degree. *Introduction to Logic* is a terminal course. It is not a prerequisite for any course, but it empowers the students with analytical skills the students can use in many aptitude tests and satisfies other needs such as meeting the requirement for many degrees in business, the sciences, and the social sciences.

Broad Course Objectives: This course supports the following goals of the Math Department:

- Engage students in sound mathematical thinking and reasoning. This should include students finding patterns, generalizing, and asking/answering relevant questions.
- Provide a setting that prepares students to read and learn mathematics on their own.
- Explore multiple representations of topics including graphical, symbolic, numerical, oral, and written. Encourage students to make connections among the various representations to gain a richer, more flexible understanding of each concept.
- Analyze the structure of real-world problems and plan solution strategies. Solve the problems using appropriate tools.
- Develop a mathematical vocabulary by expressing mathematical ideas orally and in writing.
- Enhance and reinforce the student's understanding of concepts through the use of technology when appropriate.

Topical Outline with Specific Course Objectives:

I. *Introduction to Basic Concepts of Logic*
   A. Recognize an argument
      1. Determine the premises
      2. Determine the conclusion
   B. Recognize deductive arguments
      1. Valid
         a) *Sound*
         b) *Unsound*
      2. Invalid (and unsound)
   C. Recognize Inductive Arguments
      1. Strong
         a) *Cogent*
         b) *Uncogent*
      2. Weak (and uncogent)

II. *Informal Fallacies*
   A. Recognize instances of fallacies of relevance including:
      1. Argumentum ad baculum
      2. Argumentum ad hominem
      3. Argumentum ad populum
      4. Argumentum ad misericordiam
      5. Argumentum ad ignorantiam
      6. Argumentum ad vericundiam
      7. Accident
      8. Converse Accident
      9. False Cause
      10. Petitio Principii
      11. Complex Question
      12. False Dichotomy

B. Recognize instances of fallacies of ambiguity, including:
   1. Equivocation
   2. Amphiboly
   3. Composition
   4. Division

III. Categorical Propositions

A. Recognize and classify a standard-form categorical proposition as to:
   1. Form
   2. Quantifier
   3. Copula
   4. Subject term
   5. Predicate term
   6. Quantity
   7. Quality
   8. Distribution or non-distribution of terms by the proposition

B. Use the traditional square of opposition to form valid inferences using the relationships of:
   1. Contrary
   2. Subcontrary
   3. Sub-alternation
   4. Contradictory

C. Recognize and perform the immediate inference operations
   1. Conversion
   2. Obversion
   3. Contraposition

D. Use the modern square of opposition
   1. Make inferences using the relationship of contradictory.
   2. Recognize the existential fallacy.

E. Use 2-class Venn diagrams to:
   1. Visually represent the class relationship expressed in each categorical proposition.
   2. Validate the relationships found in the squares of opposition.
   3. Validate the inferences of conversion, obversion and contraposition.

IV. Categorical Syllogisms

A. Recognize a categorical syllogism and put it in standard form by:
   1. Recognizing the major, minor and middle terms.
   2. Recognizing the major and minor premises, and the conclusion.

B. Classify a standard-form categorical syllogism as to:
   1. Mood
   2. Figure
   3. Test a given mood-figure form for validity

C. Test a syllogism for validity by:
   1. Venn diagram method
   2. Method of the syllogistic rules
   3. Numerical or other method

D. Test the validity of:
   1. Categorical arguments that can be reduced to logically equivalent standard-form syllogisms
   2. Categorical arguments that can be evaluated using diagrams representing four and five categories
   3. Sorites and/or enthymemes

V. Truth-Functional Logic

A. Symbolize any combination of the five (5) types of compound statements (below) in propositional logic.
   1. Conjunction
   2. Disjunction
   3. Conditional
   4. Bi-conditional
   5. Negation

B. Apply the definitional truth tables for each of the five (5) truth functional connectives in order to:
   1. Assess the truth-value of a statement based on the given values of its atomic components.
   2. Test the logical equivalence of two statement forms using truth tables.
   3. Classify statement forms as to contingent truths, logical truths or self-contradictions by means of truth tables.
   4. Test argument forms for validity by means of truth tables.
   5. Use indirect (shortcut) truth tables to test validity of argument forms.
   6. Test the consistency of sets of premises by the indirect truth table method.

VI. Formal Deductive Proof

A. Recognize instances of any of the following nine rules of inference:
   1. Modus ponens
   2. Modus tollens
   3. Disjunctive syllogism

4. Hypothetical syllogism
5. Constructive dilemma
6. Simplification
7. Addition
8. Conjunction
9. Absorption

B. Recognize instances of the use of the rule of replacement with any of the following ten tautologous bi-conditionals:
   1. DeMorgan's theorems
   2. Commutation
   3. Association
   4. Distribution
   5. Double negation
   6. Transposition
   7. Material implication
   8. Material equivalence
   9. Exportation
   10. Tautology

C. Recognize both the specific form and any non-specific forms of an argument:
   1. Given the argument in verbal form.
   2. Given the argument in symbolic form.

D. Use the method of deduction and the 19 rules of deduction to formulate:
   1. Direct proofs
   2. Indirect proofs
   3. Conditional proofs
   4. Natural deduction of tautologies
   5. Proofs involving inconsistent premises

Evaluation: Each instructor will determine the specific criteria to be used in determining the final course grade. These criteria will be delineated in the first-day handout provided to each student. Each instructor will give a comprehensive final exam during the assigned final exam period.

Commonality: All instructors will use the same textbook and cover all topics in the topical outline. Individual instructors may add one or more topics as time and philosophical continuity permit.