Northern Marianas College
CURRICULUM ACTION REQUEST

Effective Semester / Session: Fall 2006

Type of Action:

X New
_ Modification
_ Cancellation

Course Alpha and Number: MA 141

Course Title: Contemporary Mathematics

Reason for initiating, revising, or canceling:
This course is created primarily for NMC students majoring in, or intending to major in, non-science/math/engineering-related degree programs and who need a transferable college-level math course. The credits from this course can also meet the mathematics requirement for NMC's Associate in Arts degree in Liberal Arts.

Proposer — Date 4/17/06

Department Chair — Date 4/17/06

English and Format Reviewer — Date 5/4/06

Academic Council Chair — Date 5/4/06

Dean of Academic Programs and Services — Date 5/8/06.

Northern Marianas College
Course Guide

Course: MA 141 Contemporary Mathematics

1. Department

Sciences, Mathematics, & Technology

2. Purpose

The purpose of this course is to have available at NMC a transferable college-level mathematics course that will be an alternative to Math 161, College Algebra. Students who are pursuing degrees in disciplines such as liberal arts or the life sciences can succeed in their fields of study without the information and concepts taught in a College Algebra class. Yet, a college-level mathematics class which includes mathematical models, critical thinking, and higher-level cognitive reasoning is required in order to complete a degree at most, if not all, universities and four-year colleges. Mathematical models are the tools of choice for modeling and solving many complex problems. This course will engage students in the connections between mathematical models, contemporary mathematics and modern society. This course is also structured to engage students in logic, reasoning, and critical thinking skills, and to familiarize students with how and why mathematics is widely used in contemporary society.

3. Description

A. Required/Recommended Textbook(s) and Related Materials

Required: CONAP, For All Practical Purposes: Introduction to Contemporary Mathematics, 6th edition.
W.H. Freeman and Company: New York, NY, 2003.

Readability level: Grade 12.0

B. Contact Hours

1. **Lecture:** 4 hours per week / 60 hours per semester
2. **Lab:** None
3. **Other:** None

C. Credits

1. **Number:** 4
2. **Type:** Regular degree credits

D. Catalogue Course Description

This course is designed to help develop mathematical modeling and critical thinking skills in students who are pursuing degrees in liberal arts or the life sciences. Students will be engaged in logic, reasoning, mathematical modeling and critical thinking, and will learn how and why

mathematical models are the tool of choice for solving many complex problems in contemporary society. This course includes elements of mathematics-related topics such as networking and circuits, planning and scheduling, linear programming, producing and exploring data, game theory, probability and statistics, apportionment and voting systems, growth and form, symmetry and patterns, consumer finance, and economics of resources. Prerequisite: a "C" or better in MA 132, or instructor's permission. English Placement Level: EN 101.

E. Degree or Certificate Requirements Met by Course

A "C" grade or higher satisfies the core course requirement in mathematics for the Associate in Arts degree in Liberal Arts and for all other Associate degrees except for those that require MA 161.

F. Course Activities and Design

Course activities include lecture, group discussions, homework assignments, viewing relevant audio-visual material, calculator exploration, tests, quizzes, and a comprehensive final exam. Students will be required to participate fully in class discussions, student projects, writing activities, and other course assignments, depending upon the individual instructor.

4. Course Prerequisite(s); Concurrent Course Enrollment; Required English/Mathematics Placement Level(s)

Prerequisites: A "C" grade or higher in MA 132, or instructor's permission.
English Placement Level: EN 101.
Math Placement Level: MA 161.

5. Estimated Cost of Course; Instructional Resources Needed

Cost to the Student: Tuition for a 4-credit course, cost of textbook and graphing calculator.

Cost to the College: Instructor's salary.

Instructional resources needed for this course include: computers and software, TV/VCR, chalk.

Northern Marianas College
Course Guide

Course: MA 141 Contemporary Mathematics

6. Method of Evaluation

Student grades will be based on the regular letter grade system as described below:

A: Excellent – grade points: 4.0;
B: Above average – grade points: 3.0;
C: Average – grade points: 2.0;
D: Below average – grade points: 1.0;
F: Failure – grade points: 0.0.

NMC's grading and attendance policies will be followed.

7. Course Outline

This is a topical outline and does not necessarily indicate the sequence in which the material will be presented.

Core Material Outline

1.0 Street Networks
- 1.1 Euler Circuits
- 1.2 Finding Euler Circuits
- 1.3 Hamiltonian Circuits
- 1.4 Circuits with Reused Edges
- 1.5 Circuits with More Complications

2.0 Planning and Scheduling
- 2.1 Scheduling Tasks
- 2.2 Critical-Path Schedules
- 2.3 Independent Tasks
- 2.4 Bin Packing
- 2.5 Resolving Conflict

3.0 Linear Programming
- 3.1 Mixture Problems
- 3.2 Mixture Problems Having One or Two Resources
- 3.3 The Corner Point Principle
- 3.4 Linear Programming: The Wider Picture
- 3.5 The Simplex Method

Northern Marianas College
Course Guide

Course: MA 141 Contemporary Mathematics

4.0 Producing Data
- 4.1 Sampling
- 4.2 Bad Sampling Methods
- 4.3 Simple Random Samples
- 4.4 Statistical Estimation
- 4.5 Experiments
- 4.6 Statistical Evidence
- 4.7 Statistics in Practice

5.0 Exploring Data
- 5.1 Displaying Distributions: Histograms
- 5.2 Means and Medians
- 5.3 The Five-Number Summary and Boxplots
- 5.4 Describing Spread: The Standard Deviation
- 5.5 Least Squares Regression
- 5.6 Modern Data Analysis

6.0 Probability
- 6.1 Probability Models
- 6.2 Probability Principles
- 6.3 Distributions
- 6.4 The Mean of a Probability Model
- 6.5 Normal Curves
- 6.6 The Central Limit Theorem

7.0 Growth and Form
- 7.1 Geometric Similarity
- 7.2 Measurements
- 7.3 Scales
- 7.4 Similarity and Growth

8.0 Symmetry and Patterns
- 8.1 Number Patterns
- 8.2 Phi
- 8.3 Analyzing Patterns
- 8.4 Symmetry Groups

9.0 Consumer Finance
- 9.1 Arithmetic, Geometric, and Real Growth
- 9.2 Interest
- 9.3 Loans
- 9.4 Stocks
- 9.5 Exponential Decay

Northern Marianas College
Course Guide

Course: MA 141 Contemporary Mathematics

9.6 The Consumer Price Index

10.0 The Economics of Resources
- 10.1 Growth Models for Biological Populations
- 10.2 Limitations on Biological Growth
- 10.3 Nonrenewable Resources
- 10.4 Renewable Resources
- 10.5 Dynamic Systems
- 10.6 Mathematical Chaos

Elective Material Outline

11.0 Transmitting Information
- 11.1 Check Digits, ZIP Codes, and Bar Codes
- 11.2 Binary Codes
- 11.3 Encoding & Decoding
- 11.4 Cryptography

12.0 Voting Systems
- 12.1 Weighted Voting Systems
- 12.2 Equivalent Voting Systems
- 12.3 The Power Index

13.0 Apportionment
- 13.1 The Apportionment Problem
- 13.2 The Hamilton Method
- 13.3 Divisor Methods

14.0 Tilings
- 14.1 Regular Polygons
- 14.2 Regular Tilings
- 14.3 Tilings With Irregular Polygons
- 14.4 M. C. Escher and Tilings
- 14.5 Tiling by Translations and Half-Turns

15.0 Game Theory: The Mathematics of Competition
- 15.1 Two-Person Total-Conflict Games: Pure Strategies
- 15.2 Two-Person Total-Conflict Games: Mixed Strategies
- 15.3 Partial-Conflict Games
- 15.4 Larger Games
- 15.5 Using Game Theory

Northern Marianas College
Course Guide

Course: MA 141 Contemporary Mathematics

8. Instructional Goals

This course will introduce students to:

1.0 Street networks and Euler circuits;
2.0 Hamiltonian circuits and the Traveling Salesman Problem;
3.0 Minimum-cost spanning trees and critical-path analysis;
4.0 The optimization algorithms of management science; e.g., Kruskal's, Heuristic, Nearest Neighbor, and Sorted-edges;
5.0 The management science of planning and scheduling;
6.0 Task and critical-path scheduling and conflict resolution;
7.0 Mixture problems using one or two resources;
8.0 The Corner-point Principle and optimal production;
9.0 The Simplex method;
10.0 The principles of producing statistical data;
11.0 Statistical inference and sampling methods;
12.0 Statistical comparative experiments and evidence;
13.0 Exploratory data analysis and its applications;
14.0 The descriptive statistics of histograms, stem-plots, scatter-plots, box-plots, and regression lines;
15.0 The descriptive statistics of means, medians, quartiles, five-number summaries, and standard deviations;
16.0 Probability models and rules;
17.0 Sample spaces and sampling distributions;
18.0 Normal distributions and normal curves;
19.0 The Central Limit Theorem;
20.0 Statistical inference and confidence intervals;
21.0 Geometric similarity;
22.0 Measuring length, area, volume, and weight;
23.0 Scaling real objects;
24.0 The language of growth, enlargement, and decrease;
25.0 Fibonacci numbers and the golden ratio;
26.0 Analyzing patterns and symmetry groups;
27.0 Arithmetic versus geometric growth;
28.0 Simple versus compound interest;
29.0 Exponential growth and decay, and the natural number *e*;
30.0 The Consumer Price Index;
31.0 Valuing a stock;
32.0 Loan rates and conventional loans;
33.0 Annuities;
34.0 Geometric growth models for biological populations;
35.0 Limitations on biological growth; and

36.0 The economics of harvesting nonrenewable and renewable resources.

Elective Material Goals

37.0 The principles behind Zip Codes and barcodes;
38.0 Binary codes and check digits;
39.0 Encryption and decoding;
40.0 Boolean logic;
41.0 Voting systems and social choice;
42.0 The Apportionment Problem;
43.0 Apportionment methods; and
44.0 Strategies and payoffs of game theory.

9. Student Learning Outcomes

Upon successful completion of this course, students will be able to:

Core Material Outcomes

1.0 Draw graphs of street networks and recognize Euler circuits;
2.0 Find minimum costs using Hamiltonian circuits and use various algorithms and methods for solving the Traveling Salesman Problem;
3.0 Find minimum-cost spanning trees and use critical-path analysis for scheduling problems;
4.0 Utilize the algorithms of management science in optimization problems;
5.0 Use principles of management science for planning and scheduling;
6.0 Analyze tasks, construct critical-path schedules and resolve scheduling conflicts;
7.0 Set up and solve mixture problems using one or two resources for maximization or minimization;
8.0 Use the Corner-point Principle for optimal production;
9.0 Be familiar with the Simplex method;
10.0 Know the principles of producing statistical data;
11.0 Apply statistical sampling methods and use statistical inference to reach conclusions about data;
12.0 Understand how statistical comparative experiments are designed and evidence interpreted;
13.0 Know how to examine data using exploratory data analysis and understand its applications;
14.0 Use graphical displays of histograms, stem-plots, scatter-plots, box-plots, and regression lines to examine and interpret statistical data;

Northern Marianas College
Course Guide

Course: MA 141 Contemporary Mathematics

15.0 Know and use means, medians, quartiles, five-number summaries, and standard deviations to examine and interpret statistical data;
16.0 Use probability models and probability rules to determine the possibility and probability of outcomes;
17.0 Know the definition of sample spaces and sampling distributions;
18.0 Recognize and know the rule for normal distributions and the shape of normal curves;
19.0 Use the Central Limit Theorem to determine the probabilities of events;
20.0 Use methods of statistical inference to draw conclusions about a population from a sample and include estimates of confidence;
21.0 Recognize objects with geometric similarity;
22.0 Convert measurements of length, area, volume, and weight of objects between different measurement systems;
23.0 Understand and use scaling factors on real objects;
24.0 Know the language of growth, enlargement, and decrease;
25.0 Recognize Fibonacci numbers and use them to understand and explore the golden ratio;
26.0 Analyze patterns and symmetry groups;
27.0 Know how arithmetic and geometric growth are applied to consumer finance;
28.0 Know how to use the simple interest and compound interest formulas and the limitations of compound interest;
29.0 Understand how to use exponential growth and decay models and the natural number *e*;
30.0 Know the definition of and how to find the Consumer Price Index;
31.0 Know how to find the value of a stock;
32.0 Know the terminology of loan rates and understand how conventional loans are amortized;
33.0 Understand the principles of ordinary annuities;
34.0 Recognize geometric growth models for biological populations;
35.0 Know limitations on biological growth; and
36.0 Understand the economics of harvesting nonrenewable and renewable resources.

Elective Material Outcomes

37.0 Understand the principles behind Zip Codes and barcodes;
38.0 Read binary codes and understand the use of check digits;
39.0 Be familiar with encryption and decoding methods;
40.0 Apply Boolean logic to a web search;
41.0 Know the different voting systems and the problems of social choice;

42.0 Know how to use the Apportionment Problem in any apportionment method;
43.0 Understand apportionment methods in assigning representatives from the states to the U.S. Congress; and
44.0 Be familiar with the strategies and payoffs of game theory.

10. **Assessment Measures**

Assessment of student learning may include, but not be limited to, the following:

1.0 Periodic testing and a final comprehensive examination to evaluate the students' knowledge and abilities in cognitive reasoning and the interpretation, identification, comprehension, calculation and application of the basic concepts of mathematical modeling.

2.0 A research project that incorporates mathematical modeling. The research project should demonstrate the student's understanding of the principles of mathematical modeling.

3.0 A student presentation that illustrates the relationship between mathematical modeling and science, engineering, architecture, political systems, or other real-life applications.