MISSOURI WESTERN STATE UNIVERSITY

COLLEGE OF SCIENCE AND HEALTH

DEPARTMENT OF COMPUTER SCIENCE, MATHEMATICS, AND PHYSICS

COURSE NUMBER: MAT 110E

COURSE NAME: Contemporary Problem Solving

COURSE DESCRIPTION:

Mathematics for solving selected real-world problems using elementary graph theory, data analysis, probability, and the mathematics of finance.
Same as MAT 110. (4 credit hours: 3 hours lecture, 2 hours lab)

PREREQUISITE:
Corequisite enrollment in both a lecture section and a lab section of MAT110E.

TEXT: This course does not require any textbooks

TECHNOLOGY:

Use of scientific calculators will be required throughout the course and each student must have access to a suitable scientific calculator. The scientific calculator must have logarithmic and exponential capabilities, and depending on the instructor, the ability to do combinations and permutations.

COURSE OBJECTIVES:

Mathematics is important in the life of every citizen and, in particular, in the life of every college graduate. Colleges and universities should strive to ensure that every graduate has achieved quantitative literacy in the sense of being able confidently to analyze, discuss, and use quantitative information; to develop a reasonable level of facility in mathematical problem solving; to understand connections between mathematics and other disciplines; and to use these skills as an adequate base for life-long learning.
(FOCUS, Volume 13, Number 3, June 1993)

This course is intended to satisfy the general studies mathematics requirement for a baccalaureate degree. It is also designed to produce mathematically literate citizens by illustrating practical applications of mathematics. In order to meet these goals, students will learn how to:

1. Recognize real-world problems as network problems; translate these problems into graph theoretical language; choose an appropriate technique for solving the problem.

2. Use counting techniques to determine the number of ways of performing various tasks; relate this to probability.

3. Use basic rules of probability to find probabilities; draw a probability tree and compute basic conditional probabilities with a tree.

4. Construct various visual displays of data; calculate the measures of central tendency and dispersion; understand the properties of the normal distribution and calculate its probabilities.

5. Use the mathematics of finance to compute interest, future value, finance charges, monthly payments, and present value.

6. Communicate mathematical ideas correctly both symbolically and verbally.

The instructor may determine additional objectives based on additional material that may be covered in the course.

STUDENT COMPETENCIES:

In order to meet the above objectives, successful students will be able to do or perform the following:

1. Build a graph theoretical model of a real-world situation. *(Mathematical Reasoning & Modeling IV)*

2. Determine whether a graph has an Euler circuit, and if it does, find the Euler circuit. *(Mathematical Reasoning & Modeling IV)*

3. Eulerize a graph that is not Eulerian. *(Mathematical Reasoning & Modeling IV)*

4. Find a Hamilton path and Hamilton circuit of a graph. *(Mathematical Reasoning & Modeling IV)*

5. Determine whether a graph is complete. *(Mathematical Reasoning & Modeling IV)*

6. Solve a Traveling Salesman Problem using the Brute-Force Algorithm, the Nearest Neighbor Algorithm, and the Best-Edge (Cheapest Link) Algorithm. *(Mathematical Reasoning & Modeling IV)*

7. Use the Fundamental Counting Principle. *(Mathematical Reasoning & Modeling IV)*

8. Identify whether a combination or permutation would be appropriate to count the elements of a given set. *(Mathematical Reasoning & Modeling IV)*

9. Compute probabilities using counting techniques.
(Mathematical Reasoning & Modeling IA, IIC)

10. Compute probabilities using a probability tree.
(Mathematical Reasoning & Modeling IA, IIC)

11. Construct visual displays of data including a frequency table and a histogram.
(Mathematical Reasoning & Modeling IIA)

12. Compute the mean, median, and find the mode of a given data set.
(Mathematical Reasoning & Modeling IIB)

13. Find the values in the Five-Number Summary.
(Mathematical Reasoning & Modeling IIB)

14. Determine the range and the standard deviation of a data set.
(Mathematical Reasoning & Modeling IIB)

15. Understand the properties of the normal distribution; compute z-scores and determine probabilities using the standard normal table.
(Mathematical Reasoning & Modeling IA, IB, IIC, IID)

16. Find and interpret a confidence interval.
(Mathematical Reasoning & Modeling IID)

17. Use percentages, ratios, and proportions to determine costs of goods.
(Mathematical Reasoning & Modeling IA, IB)

18. Determine personal marginal rate on a tax schedule.
(Mathematical Reasoning & Modeling IA)

19. Compute and compare simple interest, compound interest, and determine the future value of an account for each type of interest.
(Mathematical Reasoning & Modeling IIIA, IIIC)

20. *Calculate the interest rate for simple interest and compound interest bearing accounts. (Mathematical Reasoning & Modeling IIIA)*

21. Calculate the time necessary for a current account to reach a desired amount using appropriate units. *(Mathematical Reasoning & Modeling IB)*

22. Find the future value of an ordinary annuity, as well as determine the payments of a sinking fund. *(Mathematical Reasoning & Modeling IIIB, IIIC)*

23. Compute the payments of an amortized loan and the present value of an annuity.
(Mathematical Reasoning & Modeling IIIB, IIIC)

24. Analyze the effects of refinancing or paying ahead on an amortized loan. *(Mathematical Reasoning & Modeling IIIC)*

The instructor may identify additional competencies based on other material that may be covered in the course.

COURSE OUTLINE:

I. Graph Theory
   A. Euler Circuits and Applications
   B. The Traveling Salesman Problem
      1. Hamiltonian Circuits
      2. Nearest Neighbor Algorithm
      3. Best Edge (Cheapest Link) Algorithm
   C. Trees and Kruskal's Algorithm

II. Data Analysis and Probabilities
   A. Counting
      1. Trees and Lists
      2. The Fundamental Counting Principle
      3. Combinations and Permutations
   B. Probability
      1. Sample Spaces and Events
      2. Basic Properties of Probability
      3. Probability Trees and Conditional Probability
   C. Descriptive Statistics
      1. Visual Displays of Data
      2. Measures of Central Tendency
      3. Measures of Dispersion
      4. The Normal Distribution
         a. Properties
         b. Areas under the Standard Normal Curve
      5. Confidence Intervals

III. The Mathematics of Finance
   A. Percentages
      1. Percentages
      2. Bill Splitting
      3. Pricing of Goods
      4. Taxes, Marginal Rate
   B. Interest
      1. Simple Interest
      2. Compound Interest
      3. Future Value of an Account
   C. Annuities
      1. Future Value of an Ordinary Annuity
      2. Payment for a Sinking Fund

D. Amortization
    1. Payment on an Amortized Loan
    2. Present Value of an Annuity

IV. Other Mathematics Applications

The instructor shall determine other material to be covered in this course. These topics should include applications of mathematics related to problem solving. Topics may include but are not limited to the following: Set Theory, Logic, Voting Theory, Apportionment, Geometry, Algebraic Models, Matrices, Number Theory, Mathematical Applications of Music.

GENERAL EDUCATION GOALS AND COMPETENCIES:

As noted above, this course is intended to satisfy the general studies mathematics requirement for a baccalaureate degree at Missouri Western State University. Specifically, upon successful completion of this course, students will have demonstrated the ability to think critically and reason analytically, and will have developed an understanding of fundamental mathematical concepts and their applications.

Furthermore, upon successful completion of this course, the following state-level goals and competencies will have been met:

I. Skills Areas
    a. Communicating
        Students will demonstrate the ability to…
        6. Use mathematical and statistical models, standard quantitative symbols and various graphical tactics to present information with clarity, accuracy and precision.
    b. Higher-Order Thinking
        Students will demonstrate the ability to…
        1. Recognize the problematic elements of presentations of information and argument and to formulate diagnostic questions for resolving issues and solving problems.
        2. Use linguistic, mathematical or other symbolic approaches to describe problems, identify alternative solutions, and make reasoned choices among those solutions.
        3. Analyze and synthesize information from a variety of sources and apply the results to resolving complex situations and problems.
        4. Defend conclusions using relevant evidence and reasoned arguments.
        5. Reflect on and evaluate their critical-thinking processes.

II. Knowledge Areas
    c. Mathematics
        Students will demonstrate the ability to…
        1. Describe contributions to society from the discipline of mathematics.

2. Recognize and use connections within mathematics and between mathematics and other disciplines.
3. Read, interpret, analyze and synthesize quantitative data (e.g., graphs, tables, statistics, survey data) and make reasoned estimates.
4. Formulate and use generalizations based upon pattern recognition.
5. Apply and use mathematical models (e.g., algebraic, geometric, statistical) to solve problems.