CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS
NEW COURSE PROPOSAL

DATE  9/25/09
PROGRAM AREA  MATHEMATICS

1. Catalog Description of the Course. [Follow accepted catalog format.]

Prefix MATH Course# 570  Title COMBINATORICS  Units (3)
3 hours lecture/discussion per week
hours lecture per week
Prerequisites Graduate standing or permission of instructor
Corequisites
Description  Study of arrangements, patterns, designs, assignments, schedules, connections, and configurations. Existence problems, counting methods and optimization issues. Applications include graphs, networks, experimental design, coding theory, and combinatorial optimization.

Graded
Gen Ed
CR/NC
Repeatable for up to units
Lab Fee Required
A - F
Total Completions Allowed 1
Optional (Student’s choice)
Multiple Enrollment in same semester

2. Mode of Instruction.

<table>
<thead>
<tr>
<th>Units</th>
<th>Hours per Unit</th>
<th>Benchmark Enrollment</th>
<th>Graded Component</th>
<th>CS #</th>
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</thead>
<tbody>
<tr>
<td>Lecture 3</td>
<td>1</td>
<td>25</td>
<td></td>
<td>(filled in by Dean)</td>
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<tr>
<td>Seminar</td>
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<td>Laboratory</td>
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<td>Activity</td>
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3. Justification and Learning Objectives for the Course. (Indicate whether required or elective, and whether it meets University Writing, and/or Language requirements) [Use as much space as necessary]

This course will serve as an elective in the Masters in Mathematics degree program and the Masters in Computer Science degree program. It was taught as a Special Topics course during S'09 and deemed to be a good fit for the MS Math and CS programs with few changes. It provides students different perspectives on and tools for modeling and solving complex mathematical problems.

Students who successfully complete this course will be able to
• Demonstrate skills in mathematical problem-solving in combinatorial contexts
• Analyze vertex-edge graphs for specific properties and invariants
• Apply combinatorial reasoning and combinatorial models to problems stemming from various fields of application
• Work collaboratively to explore and solve complex problems
• Express combinatorial ideas in oral and written form, using proper terminology and reasoning

4. Is this a General Education Course  YES ☐ NO ☒

If Yes, indicate GE category and attach GE Criteria Form:

A (English Language, Communication, Critical Thinking)
A-1 Oral Communication ☐
A-2 English Writing ☐
A-3 Critical Thinking ☐

B (Mathematics, Sciences & Technology)
B-1 Physical Sciences ☐
B-2 Life Sciences – Biology ☐
B-3 Mathematics – Mathematics and Applications ☐
B-4 Computers and Information Technology ☐

C (Fine Arts, Literature, Languages & Cultures)
C-1 Art ☐
C-2 Literature Courses ☐
C-3a Language
C-3b Multicultural
D (Social Perspectives)
E (Human Psychological and Physiological Perspectives)
UD Interdisciplinary

5. Course Content in Outline Form. [Be as brief as possible, but use as much space as necessary]
Instructors teaching this course would be expected to guide students through approximately two-thirds of the topics listed below, with discretion left to the instructor as to choice of topics and potential supplemental topics.

### Classic Combinatorial Topics

- Introduction to Combinatorics – Counting Problems
- Pigeonhole Principle
- Basic Counting Principles
- Permutations and Combinations
- Permutations and Combinations of Multisets (including those with infinite repetition numbers)
- Principle of Inclusion-Exclusion
  - Combinations with limited repetition
  - Derangements
  - Arrangements with forbidden positions
  - Arrangements with forbidden relative positions
  - Systems of Distinct Representatives
- Combinatorial Reasoning – Double-Counting Proofs
- Recurrence Relations
- Solving Linear Recurrence Relations
- Generating Functions (regular and exponential)
- Partitions
- Combinatorial Reasoning – Double-Counting Proofs
- Introduction to Ramsey Numbers

### Graph Theoretic Topics

- Intro. to Graph Theory
  - Basics facets of graphs
  - Isomorphism
  - Degree sequences and facts re degree
  - Isomorphism
  - Bipartite Graphs; Matchings in Bipartite Graphs
  - Eulerian Trails
  - Hamilton Paths and Cycles
  - Adjacency Matrices
  - Trees
    - Alternative definitions -- consistency
    - Growing trees
    - Spanning trees
    - Algorithms to create spanning trees
    - Applications of Shortest-Path Spanning Trees
- Stable Marriage Problems
- Graph Numbers
  - Chromatic number
  - Independence number
  - Clique number
  - Clique-partition number
  - Domination number
  - Various graph-labeling numbers
- Vertex and edge connectivity

Please note: the form does not allow much formatting. Items with open bullets are subtopics of the topic they follow.

Does this course overlap a course offered in your academic program?  YES [ ] NO [X]

If YES, what course(s) and provide a justification of the overlap?

Does this course overlap a course offered in another academic area?  YES [ ] NO [X]

If YES, what course(s) and provide a justification of the overlap?

Signature of Academic Chair(s) of the other academic area(s) is required on the signature sheet below.

6. **Cross-listed Courses (Please fill out separate form for each PREFIX)**
List Cross-listed Courses

Signature of Academic Chair(s) of the other academic area(s) is required on the signature sheet below.

Department responsible for staffing: Mathematics

7. References. [Provide 3 - 5 references on which this course is based and/or support it.]

Applied Combinatorics, 2nd Edition, Fred S. Roberts and Barry Tessman
Combinatorics: Topics, Techniques, Algorithms, Peter J. Cameron
Introduction to Graph Theory, 2nd Edition, Douglas B. West

8. List Faculty Qualified to Teach This Course.

Mathematics faculty

   a. Projected semesters to be offered: Fall ☐ Spring ☒ Summer ☐

10. New Resources Required. YES ☒ NO ☐
    If YES, list the resources needed and obtain signatures from the appropriate programs/units on the sheet below.
    
    a. Computer (data processing), audio visual, broadcasting needs, other equipment) existing
    b. Library needs existing
    c. Facility/space needs existing

11. Will this new course alter any degree, credential, certificate, or minor in your program? YES ☒ NO ☐
    If, YES attach a program modification form for all programs affected.

Cindy Wyels  10/25/09
Proposer of Course  Date
Approval Sheet
Program/Course:

________________________________________________________
Program Chair(s)                  Date

________________________________________________________
General Education Chair(s)        Date

________________________________________________________
Curriculum Committee Chair(s)     Date

________________________________________________________
Dean of Faculty                    Date