ROCHESTER INSTITUTE OF TECHNOLOGY

GOLISANO COLLEGE OF COMPUTING AND INFORMATION SCIENCES
DEPARTMENT OF COMPUTER SCIENCE

CSCI-761
Title of course: Topics in Advanced Algorithms
New Topic: Topics in Combinatorial Computing

1.0 Course Information

a) Catalog Listing (click HERE for credit hour assignment guidance)

Course title (100 characters)	**Topics in Advanced Algorithms**
Transcript title (30 Characters)	**Topics in Combinatorial Computing**
Credit hours	3
Prerequisite(s)**	CSCI-665 or ((CSCI-261 or CSCI-264) and permission of the instructor)
Co-requisite(s)	none

b) Terms(s) offered (check at least one)

	Fall
x	Spring
	Summer
	Other
	Offered biennially

If "Other" is checked, explain:

c) Instructional Modes (click HERE for credit hour assignment guidance)

	Contact hours	Maximum students/section
Classroom	3	30
Lab		
Studio		
Other (specify, i.e. online, workshop seminar, etc.)		

2.0 Course Description (as it will appear in the bulletin)

This course focuses on advanced algorithms and data structures in a specialized area of computer science or in a specific scientific domain. Both practical and theoretical aspects of algorithms will be explored to provide coverage of the state of the art and shortcomings of computing in the specialized area. This includes proofs of correctness

and complexity analysis of the algorithms. Students will write a term paper that explores the current state of research in the area or reports on the student's implementation and experiments with algorithms for a chosen problem. Students will also be required to make presentations.

The instructor will post the specifics of each course offering before the registration. With the approval of the program coordinator, this course can be taken for credit more than once, provided each instance concerns a different specialized area or domain.

3.0 Goal(s) of the Course

3.1 Many areas of computer science or computing fields in specialized scientific domains are based on a rich set of algorithms and data structures, for whose study there is no space in traditional courses. Becoming a computing expert in a domain is greatly facilitated by knowing its algorithms in depth.

In this course students will gain in-depth understanding, both practical and theoretical, of algorithms and data structures in a specialized area of computer science or in a specific application domain. The students will also gain insight at the state of the art and shortcomings of computing in a chosen area. This course may count towards different clusters depending on the area of the course instance, after approval of the relevant cluster head(s).

4.0 Intended course learning outcomes and associated assessment methods

Include as many course-specific outcomes as appropriate, one outcome and assessment method per row. Click HERE for guidance on developing course learning outcomes and associated assessment techniques.

Course Learning Outcome	Assessment Method
4.1. Students will be able to explain the algorithms and data structures in the chosen area. (supports program outcomes 1, 2)	Assessed by homeworks, programming exercises, and final exam.
4.2. Students will be able to analyze the applicability of the range of effective computations in the chosen area. (supports program outcomes 1, 2)	Assessed by homeworks, programming exercises, and final exam.
4.3. Students will explain the limitations of effective computation in the chosen area. (supports program outcomes 1, 2)	Assessed by homeworks and final exam.

4.4. Students will be able to present, in both oral and written form, technical results in the chosen area. (supports program outcome 2)	Assessed by a term paper or report and an oral presentation.

5.0 Topics (should be in an enumerated list or outline format)

1. Combinatorial objects – 10%
    - Overview of types of objects
    - Generation: subsets, Gray codes, permutations
    - Trees, ranking
2. Backtracking – 10%
    - Naive and enhanced backtracking
    - Generating cliques
    - Knapsack and traveling salesman problems
    - Satisfiability problem, SAT-solvers
    - Estimating size of backtrack tree
3. Heuristic searches for combinatorial configurations – 10%
    - Hill climbing
    - Simulated annealing
    - Tabu search
    - Genetic Algorithms
4. Basis reduction – 15%
    - Reduced basis
    - Solving systems of integer equations
    - Solving subset-sum problem
5. Computations in Ramsey theory – 40%, main research area of the instructor
    - Ramsey, Folkman and van der Waerden numbers
    - Constructing critical configurations
    - Computing, analyzing, and using automorphism groups of configurations
6. Computations in design theory – 15%
    - Constructing balanced incomplete block designs
    - Constructing Steiner triple systems
    - Constructing t-designs and coverings

6.0 Possible Resources (should be in an enumerated list or outline format)

Combinatorial Algorithms. Generation, Enumeration, and Search,
by Donald L. Kreher and Douglas R. Stinson, CRC Press, 1999.

Instructor's conference papers and presentations, available at
https://www.cs.rit.edu/~spr/PUBL/publ.html.

Journal papers.

7.0 Program outcomes and/or goals supported by this course (if applicable, as an enumerated list)

7.1. (CS Graduate Program Outcome 2) Demonstrate a depth of knowledge in a selected area in the discipline. 7.2. (CS Graduate Program Outcome 3) Communicate effectively in a professional environment.

8.0 Administrative Information

a) Proposal and Approval

Course proposed by	Stanisław Radziszowski
Effective term	
Required approval	Approval granted date
Academic Unit Curriculum Committee	
Department Chair/Director/Head	
College Curriculum Committee	
College Dean	

b) Special designations for undergraduate courses

The appropriate Appendix (A, B and/or C) must be completed for each designation requested. IF YOU ARE NOT SEEKING SPECIAL COURSE DESIGNATION, DELETE THE ATTACHED APPENDICES BEFORE PROCEEDING WITH REVIEW AND APPROVAL PROCESSES.

Check	Optional Designations	*** Approval date (by GEC, IWC or Honors)
	General Education	
	Writing Intensive	
	Honors	

c) This outline is for a…

	New course
	Revised course
x	Deactivated course

If revised course, check all that have changed

x	Course title		Mode of Delivery
	Credit hour		Course Description
	Prerequisites		Special Designation
	Contact hour		
	Other (explain briefly):		

d) Additional course information (check all that apply)

x	Schedule Final Exam
	Repeatable for Credit | How many times:
	Allow Multiple Enrollments in a Term
	Required course | For which programs:
x	Program elective course | For which programs: BS/MS in Computer Science