Air University
Faculty of Basic and Applied Sciences
Department of Mathematics

SUBJECT: Computer Algebra System (MA-223) (Credit Hours: 3-0-3) (Contact Hours: 3/week)

Text Book: "Computer Algebra and Symbolic Computation", Joel S, Cohen, A K Peters/CRC Press, (1st edition 2002).

Reference Book(s): 1. "Modern Computer Algebra", Gathen and J. Gerhard,University Press, (2nd edition, 2003).
2. "Algorithms for Computer Algebra", K. O. Geddes, S. R. Czapor and G. Labahn, Kluwer Academic Publishers, (1992).
3. "Computer Algebra; systems and algorithms for algebraic computation", J.H. Davenport, Y. Siret and E. Tournier, Academic Press, (1998).

Course Aim: Use the computer algebra system Axiom as an aid to solve mathematical problems, e.g., by implementing appropriate algorithms and evaluating results. Explain the gap between ideal solutions and actual systems (the need to compromise for efficiency reasons). Discuss the mathematical techniques as well as data structures used in the course and relate them to computational concerns. Discuss and apply various advanced algorithms and the mathematical techniques used in their design, applying them to related problem areas. Use the techniques of the course to design and justify an efficient algorithm for a given mathematical problem.

Course Learning Outcomes: Upon successful completion of this course, students should be able to:

1. Understanding major algorithms of symbolic computation
2. Understanding some algorithms of experimental mathematics
3. Understanding main ideas of a computer assisted proof
4. Solve mathematical problems using symbolic computation

ASSESSMENT:

Quizzes	15%
Home Assignments	5%
Mid Term Examination	35%
Final Examination	45%

COURSE BREAKDOWN / LECTURES PLAN

Week	Topic
1	general design principles, user facilities e.g. Maple or Mathematica
2	data structures, brief comparison with other systems
3	Algebraic structures: overview, basic concepts and algorithms
4-5	Arbitrary precision operations on integers, rationals, reals, polynomials and rational expressions
6	Greatest common divisors for integers
7	Plotting functions in 2D and 3D, Matrix algebra using Maple or Mathematia
8	determinants, echelon and reduced echelon form, eigen values, eigen functions
	Mid-Term
9	solution of sets of equations. Dot and Cross product of vectors, Taylor series
10	Derivation and integration of expressions. Simplification of polynomial and rational expressions, partial fractions.
11	Exact solution of ode's and system of ode's. Laplace and inverse Laplace transforms.
12	Writing procedures in Maple.
13	Single variable polynomials, degree and leading coefficients of polynomials
14	polynomial division, polynomial factorization, irreducible polynomials.
15	Greatest common divisors for univariate polynomials
16	Linear inequalities and linear programming in Maple