**PMATH 800 -- Topics in Real and Complex Analysis, Section 2: Riemann Surfaces
Course outline − Winter 2014**

Instructor: Ruxandra Moraru
Email: moraru@math.uwaterloo.ca
Office hours (MC 5170): T 10:00 – 12:00 and Th 15:00 – 17:00

Lectures: MWF 11:30 - 12:20 (MC 5136B)

Course webpage: http://www.math.uwaterloo.ca/~moraru/800_2014.html

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Overview: Riemann surfaces can be defined in several different, equivalent ways, for example as one-dimensional complex manifolds, or as oriented two-dimensional real manifolds. In addition, any compact Riemann surface can be embedded in projective space, thus giving it the structure of an algebraic curve. Riemann surfaces therefore appear in many areas of mathematics, from complex analysis, algebraic and differential geometry, to algebraic topology and number theory. This course will cover fundamentals of the theory of compact Riemann surfaces from an analytic and topological perspective.

Outline of topics: Riemann surfaces (definitions and examples, algebraic curves, quotients, modular curves); holomorphic maps; elliptic functions (Weierstrass and theta functions); sheaves and analytic continuation; maps between Riemann surfaces (basic properties, covering maps, monodromy and the Riemann Existence Theorem); holomorphic and meromorphic forms; de Rham and Dolbeault cohomology; harmonic forms and the Hodge decomposition; cohomology of sheaves; Riemann-Roch; Serre duality; maps to projective space; Riemann-Hurwitz formula; curves and their Jacobian; factors of automorphy and line bundles; automorphic forms; theta divisors and the Torelli Theorem (time permitting); the Uniformisation Theorem (time permitting).

Prerequisites: The course should be accessible to students who have taken PMATH 352 (Complex Analysis) or an equivalent course.

Required text: O. Forster, *Lectures on Riemann Surfaces*, Springer-Verlag, 1981

Additional references:
1. S. K. Donaldson, *Riemann Surfaces*, Oxford University Press, 2011
2. R. Narasimhan, *Compact Riemann Surfaces*, Birhäuser, 1992
3. H. M. Farkas and I. Kra, *Riemann Surfaces*, Springer-Verlag, 1992
4. F. Kirwan, *Complex Algebraic Curves*, Cambride University Press, 1992
5. P. Griffiths, *Introduction to algebraic curves,* American Mathematical Society, 1989
6. P. Griffiths and J. Harris, *Principles of Algebraic Geometry*, Wiley Interscience, 1978
7. E. Arbarello, M. Cornalba, P. Griffiths and J. Harris, *Geometry of Algebraic Curves: Volume I*, Springer, 1985

Method of evaluation: Your final grade will be based on 4 assignments, to be handed in class every three weeks. Assignments will be posted on the course webpage.

Schedule of assignments:
Friday, 24 Jan: Assignment 1
Friday, 14 Feb: Assignment 2
Friday, 14 Mar: Assignment 3
Friday, 4 Apr: Assignment 4

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check http://www.uwaterloo.ca/academicintegrity/for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity to avoid committing academic offenses and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the undergraduate associate dean. For information on categories of offenses and types of penalties, students should refer to Policy 71, Student Discipline, http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances (other than a petition) or Policy 71, Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72, Student Appeals, http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for students with disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.