SYLLABUS

MATH 351/551

Quaternions, Interpolation and Animation

10:30 - 11:50 M,W

(Al Khwarizmi)

Instructor: Dr. Michael Aristidou **Phone:** 425-895-4400, ext.4464
Office Hours: 12:00-12:30 M,W **E-mail:** maristidou@digipen.edu

Textbook: Class Notes (No textbook required) [1] .

Other sources: (1) *Visualizing Quaternions*, by A. J. Hanson, Morgan Kaufmann, 2006.
(2) *Quaternions and Rotation Sequences*, by J. B. Kuipers, Princeton Univ. Press, 1999.
(3) Other related papers and articles, such as:
(i) *Quaternions, Interpolation, and Animation*, by E. B. Dam, M. Koch, and M. Lillhom, Technical Report, Univ. of Copenhagen, 1998.
(ii) *Exploiting Quaternions to Support Expressive Interactive Character Motion*, by M. P. Johnson, PhD, MIT, 2003.
(iii) *Animating Rotation with Quaternion Curves*, by K. Shoemake, Siggraph Proceedings, 1985.
(iv) *Smooth Interpolation of Orientations with Angular Velocity Constraints using Quaternions*, by A. H. Barr, B. Currin, S. Gabriel, and J. Hughes, Siggraph Proceedings, 1992.
(v) *The Octonions* (section 2), by J. C. Baez, Bullentin of American Math. Society, 2002.

Course Overview: This course gives an introduction to several mathematical topics of foundational importance in abstract algebra, and in particularly in the algebra of quaternions. Topics include:

Operations, Groups, Rings, Fields, vector Spaces, Algebras, Complex Numbers, Quaternions, Curves over the quaternionic sphere, Interpolation Techniques, Splines, Octonions, and Clifford Algebras.

Goals and objectives:

(1) Familiarize students with certain abstract discrete mathematical structures, such as groups, rings, algebras, etc, and most importantly the quaternion group, quaternion algebra, and parameterized curves, and encourage them to apply the latter in graphics and other projects of their interest.
(2) Improve their problem–solving skills, develop their ability to present material and answer questions, coherently, completely and accurately, and enabling them to explain things to others clearly.
(3) Developing skills for teamwork by working in groups.

Grading: MATH 351**:** 40% - 2 Tests
40% - 2 Homework assignments (take-home)
20% - Project (15% paper + 5% 15-min presentation)
MATH 551**:** 40% - 2 Tests
30% - 2 Homework assignments (take-home)
30% - Project [2] (25% paper + 5% 15-min presentation)

(All test dates will be announced in class on due time and **NO** test scores will be dropped) [3]

Project: The project could be of practical or theoretical nature, but always related to the material and objectives of the course. Concepts from the material taught should be used within the project. Students should form groups of two individuals and cooperate. Equal contribution from both members of the group, in both the project and presentation, is expected. Each group should come up with its own project. The projects could be related to works from other courses, but they should always be relevant to the topics covered in this course.
Deadline: April 16th, 2009.

Grading Scale: The grade G for the course is then determined as follows:

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\begin{array}{ll}
\text{A} & \text{if} \quad 90\% \le G \le 100\% \\
\text{A-} & \text{if} \quad 85\% \le G < 90\% \\
\text{B+} & \text{if} \quad 83\% \le G < 85\% \\
\text{B} & \text{if} \quad 77\% \le G < 83\% \\
\text{B-} & \text{if} \quad 75\% \le G < 77\% \\
\text{C+} & \text{if} \quad 73\% \le G < 75\% \\
\text{C} & \text{if} \quad 67\% \le G < 73\% \\
\text{C-} & \text{if} \quad 65\% \le G < 67\% \\
\text{D} & \text{if} \quad 50\% \le G < 65\% \\
\text{F} & \text{if} \quad 0\% \le G < 50\% .
\end{array}
$$

Test Make-up Policy: Speak to me **before** the test or leave a telephone or an e-mail message. If you are not able to contact me before the test, contact me within the **next** couple of days. Documentation to verify the reason you missed the test is required. Only one make-up test will be allowed for the semester and that if there are extremely special circumstances.

Special needs: DigiPen Institute of Technology will provide reasonable accommodations and academic adjustments for persons with documented disabilities, as indicated in the catalog. Students need to contact the Student Services Director at the beginning of the semester to ensure that classroom and academic accommodations are implemented in a timely fashion. All communication between students, the Director of Student Services, and the professor, concerning special needs will be strictly confidential.

Class Policy: Attendance in class is expected, although not mandatory. Keep in mind, though, that if you are absent for 2 weeks, or more, you are considered to have withdrawn from the course. Also, repeated absence might result to complications with financial support for some students. If you decide to drop the course it is your responsibility to do the paperwork and follow the correct procedures. Only pencil is to be used on tests. Calculators like TI-89, or TI-83, are useful to have, but are not required. All tests must be your work. Cell phones, pagers, laptops, ipods, etc, are expected to be turned off during class. No food or drinks are allowed in class.

Academic dishonesty: Academic dishonesty (including cheating and plagiarism) is a serious matter, and will not be tolerated. It will be dealt with appropriately as indicated in the student handbook. Homework and solutions of problems should be your own work, and not be copied. It is fine to consult others and discuss problems with each other, but the final solution should be your own work and in your own words, with your own drawings and your own explanations.

***Notes*:** (1) Some useful material regarding this course, or other courses, you may here: https://digipen.edu/~maristidou

(2) Students in MATH 551 will be expected to read at least one research paper, and show some degree of originality in the content of their papers.

(3) Changes, if any, to this syllabus will be announced in class.