Akita International University

MAT100-1 Mathematics for Liberal Arts (3 credits)

Fall Semester 2009

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DESCRIPTION: This course is designed to develop multiple intellectual skills related to mathematics, selected from the point of view of their importance for the Liberal Arts education rather, than for the purpose of advancing technical proficiency in the use of mathematical methods of increased level of difficulty. Thus, the course places emphasis on the understanding of the general methods of mathematical reasoning illustrated by the most basic mathematical formalisms applied to a wide range of simple, but non-trivial problems from various domains of theoretical study or practical activity. Students are learning methods of abstract thinking formulated in terms of mathematical logic and set theory; they develop understanding of the distinction between the inductive and deductive reasoning, learn the methods of these two types of inquiry, and learn how to use these two forms of reasoning for the purpose of analysis of spatial or temporal relations; they acquire rudiments of probability theory and its applications to making decisions under the constraints of limited information.

The course can be selected as one of the two courses which have to be completed in the category of Mathematics and Natural Sciences in the Liberal Arts Distribution of Basic Education.

OBJECTIVES: Students acquire in this course an understanding of, and basic level of proficiency in the carrying on processes of logical reasoning based on the rules of inference and with the use of rudimentary tools of algebraic logic (e.g. logical operations, truth tables, etc.) and of set theory (e.g. Venn diagrams.) The understanding of the process allows them not only to perform it correctly, but also to justify the claim of its correctness.

After completion of the course students should be able to understand and apply several counting techniques of combinatorics (e.g. number of permutations, combinations, etc.) and the basic methods of probability theory, in particular in the context of making decisions under the constraints of limited information. Also, students gain the knowledge and understanding of the methods provided by mathematics (geometry, graph theory) to the analysis of spatial and temporal relations, which in addition to the recognition and appreciation of the relations between mathematical reasoning and the methods of inquiry and creativity in other disciplines, gives them the ability to perform some practical, organizational functions such as the task scheduling or fair selection under multiple

preferences.

STUDY MATERIALS:

<Textbook> David B. Johnson, Thomas A. Mowry, Mathematics: A Practical Odyssey, 6th ed., Thomson-Brooks/Cole, 2007. ISBN 0-495-01273-4, ISBN 978-0-495-01273-3

<Reference books, sources of readings and other information> Following the famous dictum of Einstein "Things should be made as simple as possible, but not simpler" several topics in this course will be presented in a way slightly different from that in the textbook. These modifications will require that some portions of the material in the textbook may be replaced by handouts prepared by the instructor. Students interested in expanding their perspectives on the subject of the course, or on mathematics in general, should ask the instructor for advice on additional, optional readings. The textbook includes some optional, but highly recommended short readings introducing the historical context to the subject of study.

ASSESSMENT: Student achievement of the course objectives is being measured in terms of student performance in completing short homework assignments (25%,) writing one more extensive assignment on the subject selected by student and approved by instructor (25%), in writing the Midterm Test (25%,) and in writing the Final Examination (25%).

Frequently, students will get homework assignment consisting of a short selection of problems related to the material covered in class. **The solutions of ALL assigned problems should be turned in before or during next class meeting**. Each time only one out of all assigned problems will be graded, but it does not limit students' responsibility to attempt solving all problems.

Although the focus of the course is on the understanding of the concepts and methods, students are not tested on their verbal knowledge of definitions or theorems. Neither lecture, nor tests are involving the proofs of theorems which have to be memorized or which require extensive practice of the methods used in mathematical proofs. However, there are frequent examples in the lecture and in the homework assignments which introduce students into mathematical thinking equivalent to proving very simple theorems. The principle is that whatever reasoning is demonstrated in the class (and expected from students in assignments or on the tests,) it should be doable by the students themselves with appropriate guidance from the instructor. For that reason, the proofs requiring proficiency in mathematical reasoning exceeding that expected from all students are omitted.

In the grading of tests, majority of credit is for the correctness of the method and for demonstrated understanding of the material. Calculation errors are mostly ignored.

ACADEMIC PREPARATION: There is no expected academic work at the college level preparing for the course. Since very little in this course will be in direct relation to the material of high school mathematics, student's progress in this course will depend mainly on his or her current work. Of course, good high school background will make studying in this course easier, as it gives students the advantage of the earlier training in mathematical reasoning, but even students who went through most limited high school mathematical education with difficulties can complete the course with a good grade, provided they attend classes regularly, complete all assignments in timely manner, and put in the study no less effort than in other courses. The expectations regarding (English) language are not going beyond the requirements for the entry into Basic Education. Actually, the course is recommended at the introductory stage of Basic Education when students are working on the development of language competence necessary for the more language demanding courses in Humanities or Social Sciences. Students who are planning to select Global Business major are welcome in this course, but they have to remember that there are other two courses in mathematics: MAT150 College Algebra and MAT200 Statistics which belong to the requirements of Global Business. MAT 100 Mathematics for Liberal Arts CANNOT replace either the two requirements for Global Business.

POLICIES: Acts of cheating or other forms academic dishonesty will be dealt with harshly.
Attendance in all classes is mandatory, whether it is being checked by instructor, or not.
It is student's responsibility to submit all assignments by the announced deadlines. Homework assignments are due on the next day of class meetings
The AIU policies on mandatory attendance and on timely submission of homework will be strictly enforced. There is no time to make up lost classes or delayed work on the assignments. Late homework WILL NOT BE ACCEPTED, unless student has a documented reason for the delay. The longest acceptable delay in the submission of the homework is one week. Students with several unexcused absences will be dismissed from the class with the failing grade.

COURSE FORMAT AND ACTIVITIES: Generally, class sessions have format of lectures with frequent interactions between the instructor and students in the form of questions and answers. Students are working outside of the class on assigned problems. Each class session begins from the time for students' questions regarding difficulties in the homework or in the material from last session. Occasionally, computer aided presentations may be used to make understanding of the material of the class easier.
In the second half of the course students will select a topic for one major homework assignment. The assignment will require preparation of a written report in the format which will be explained in class.

SCHEDULE: Homework assignments are due on the next day of classes! The only exception will be made when the cause of the delay is an officially approved absence, or when student receives prior approval from the instructor. The dates of classes are tentative. Slight changes are possible. If the date of a class is changed, so is the deadline for homework assignment.

Homework assignments should be written and submitted on separate pages (not in a notebook!) Each page should have on the top of the front page student's name and the number of the section from the textbook.

(The numbers and titles of sections and the numbers of pages are referring to the part of the textbook material related to the subject of class session)

1) 9/1 1.1 Deductive vs. Inductive Reasoning p.2
   1.2 Symbolic Logic p.19
2) 9/3 1.3 Truth Tables p.27
3) 9/8 1.4 More on Conditionals p.40
4) 9/10 1.5 Analyzing Arguments p.46
5) 9/17 2.1 Sets and Set Operations p.63
   2.2 Applications of Venn Diagrams p.75
6) 9/22 2.3 Intro to Combinatorics p.88
7) 9/24 2.4 Permutations and Combinations p.96
8) 9/29 2.5 Infinite Sets p.112
9) 10/1 3.1 History of Probability p.126
   3.2 Basic Terms of Probability p.133
10) 10/6 3.3 Basic Rules of Probability p.152
11) 10/8 3.4 Combinatorics and Probability p.164
12) 10/15 3.5 Expected Value p.175
13) 10/17 3.6 Conditional Probability p.186
   3.7 Independence p.202

END OF MATERIAL FOR MIDTERM EXAM

14) 10/20 6.1 Voting Systems p.410
15) 10/22 MIDTERM EXAM
16) 10/27 7.1 Place Systems p.477
   7.2 Arithmetic in Different Bases p.490
17) 10/29 7.3 Prime Numbers and Perfect Numbers p.499
18) 11/5 7.4 Fibonacci Numbers and Golden Ratio p.510
19) 11/10 8.1 Perimeter and Area p.523*
   8.2 Volume and Surface Area p.538*

20) 11/12 8.3 Egyptian Geometry p.550
8.4 The Greeks p.561
21) 11/17 8.5 Right Triangle Trigonometry p.574*
22) 11/19 8.6 Conic Sections and Analytic Geometry p.589
23) 11/26 8.7 Non-Euclidean Geometry p.600
24) 12/1 8.8 Fractal Geometry p.611
25) 12/3 9.1 A Walk Through Königsberg p.648
9.2 Graphs and Euler Trails p.654
26) 12/8 Hamilton Circuits p.668
27) 12/10 Networks p.682*
28) 12/15 Scheduling p.703
29) 12/17 FINAL EXAM

* Topics indicated by the asterisks are tentative. They are of secondary importance for the objectives of the course and will be covered only if time permits.