FALL 2019 Math 461 --- RINGS AND MODULES

Prerequisite: Math 367 or consent of instructor. Credits: (3-0) 3.

Instructor: Semra Öztürk, M 138, Schedule and office hours are at the address http:/www.metu.edu.tr/~sozkap/aa.pdf.

Catalog Contents: Rings, ideals, isomorphism theorems, group rings, localization, factor rings. Modules, submodules, direct products, factor modules. Homomorphisms, classical isomorphism theorems. The endomorphism ring of a module. Free modules, free groups. Tensor product of modules. Finitely generated modules over a principal ideal domain.

Grading will be based on two midterms %40 each, one final exam %50, and attendence/class participation %10.

You should take both of the midterm exams, I will omit the lower grade (even if you are happy with your first midterm grade you still have to take the second midterm exam)

Attendence is required, attendance and class participation/homeworks will be %10 of the course grade.

Description of the course: This course is to provide the background for students who are willing to learn more about rings which are the fundamental mathematical structures occuring everywhere ! It is good for everyone ☺ but especially for students who are planning to study any algebra related topics such as algebraic topology, algebraic geometry, even analysis . As the title suggests this course consists of two parts, rings and modules.
This semester I will spend less than the first half of the semester on rings and spend more time on modules. We will skip tensor products completely. Rings will be a more detailed but faster version of some of the topics you have seen in Math 367, and Math 116. Modules will be new to you. They are generalizations of vector spaces also generalization of abelian groups. Thus in module theory linear algebra comes up quite often. You should be comfortable using linear algebra to get more out of this course. We will see the primary decomposition theorem for finitely generated modules over a Euclidean domain.

Modules over group algebras are examples of groups acting on vector spaces.
About 5 – 6 weeks we will cover Rings : rings, subrings, ideals, quotient rings, annihilators, homorphism of rings, isomorphism theorem for rings, rings of fractions, Chineese remainder theorem, Euclidean domains, principal ideal domains, group algebras, polynomial rings.

About 7-- 8 weeks we will cover Modules: modules , submodules, simple modules, Schur's Lemma, generation of modules, direct sums, annilators of modules, free modules, torsion modules, torsion-free modules, finitely generated torsin free modules, modules over a Euclidean domain or over a principal ideal domain, primary decomposition theorem, elementary divisors, invariant factors, (the rational canonical form , if there is enough time and interest).

I will use two textbooks this semester :

1) **Abstract Algebra** by David S. Dummit and Richard M. Foote, Third Edition, only the Preliminaries and Chapter 7 .

2) **A First Course in Module Theory** by M. E. Keating, Imperial Clollege Press, only the Chapters 2--9

Another book that I used for this course in previous semesters (you may find it useful as well): Introduction to Rings and Modules, Second Revised Edition, by **C. Musili,** Narosa Publishing House, 1994, only *Chapters 1--5 (the part for rings is too long and the part for modules is too short)*

Week	Dates	MATH 461 Syllabus 2019-1 (T E N T A T I V E)	
1	**Sep 23-27** Nov. 23: University Opening Ceremony (Between 8:40 and 12:30 classes will not be held)	Course policies, how to study, background check etc. Preliminaries Rings: Definition and examples (Preliminaries 0.1, 0.2, 0.3 and 7.1 of the book Abstract Algebra by Dummit and	
2	**Sep30 - Oct 04** Add-Drop and Advisor Approvals	Rings : Further examples, Ring homomorphisms, Ideals, annihilators , Quotient rings, Idempotents, Boolean rings	7.1, 7.2 of the book Abstract Algebra by Dummit and Foote
3	**Oct 07-11**	Rings : Isomorphism theorems for rings, Properties of ideals	7.3, 7.4 of the book Abstract Algebra by Dummit and Foote
4	**Oct 14-18**	Rings of fractions, Chineese Remainder theorem	7.5, 7.6 of the book Abstract Algebra by Dummit and Foote
5	**Oct 21-25**	Euclidean domains,	Chapter 2 of the A First Course in Module Theory by M.E. Keating
6	**Oct 28- Nov 01** Oct.29th Tuesday: National Holiday (Republic Day)	Modules and Submodules	Chapter 3 of the A First Course in Module Theory by M.E. Keating
7	**Nov 04-08**	Modules and Submodules	Chapter 3 of the A First Course in Module Theory by M.E. Keating
8	**Nov 11-15**	Homomorphisms	Chapter 4 of the A First Course in Module Theory by M.E. Keating
9	**Nov 18-22**	Free modules	Chapter 5 of the A First Course in Module Theory by M.E. Keating
10	**Nov 25-29**	Quotient modules and cyclic modules	Chapter 6 of the A First Course in Module Theory by M.E. Keating
11	**Dec 02-06**	Direct sum of modules	Chapter 7 of the A First Course in Module Theory by M.E. Keating
12	**Dec 09-13**	Torsion and the primary decomposition	Chapter 8 of the A First Course in Module Theory by M.E. Keating
13	**Dec 16-20**	Torsion and the primary decomposition	Chapter 8 of the A First Course in Module Theory by M.E. Keating
14	**Dec 23-27**	Presentations	Chapter 9 of the A First Course in Module Theory by M.E. Keating