**MA 402 ABSTRACT ALGEBRA**

**Instructor: Dr. David Brown**

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**Office Hours: MTWF 12pm in AL 302, 3 pm in Al 303** **other times by appointments.**

**A note: For many students, this course is their first taste of abstract mathematics.  This course is required of mathematics education majors.  It gives great insight to the structure of the mathematics that we use every day.  One of the major goals of the course is to teach the students how to construct a proof.**

**Text:** **Contemporary Abstract Algebra 8th Edition by Joseph Gallian ISBN 1133599702**

**Free PDF online:**

<https://isidore.co/calibre/get/pdf/4975>

**Course Description: The theory of mathematical structures with an emphasis on group theory. Examples are taken from the real number system, linear algebra and calculus. Elements of number theory and set theory are used extensively. The study of homomorphisms, isomorphisms and related theory is included.**

**Teacher Goals:**

* **To develop the ability to recognize patterns in mathematical structures.**
* **To develop the ability to develop models for different mathematical structures.**
* **To develop the ability to illustrate definitions with examples.**
* **To develop the ability to use definitions to develop mathematical theory.**
* **To develop the ability to recognize valid proofs.**
* **To develop the ability to create proofs of theorems.**
* **To develop combinatorial mathematics skills.**
* **To teach the students the foundations of Group Theory and to give them an appreciation of its beauty.**
* **To encourage students to ask questions which lead to seeking a deeper understanding of the subject.**

**Course Objectives:**

**The student will be able:**

* **To write, at any time during the semester, the definitions of the terms and concepts that have been introduced in the course.**
* **To construct examples which illustrate terms and concepts that have been discussed. (NCTM 1.5.1)**
* **To prove theorems that have been proved in class.**
* **To work computational problems relating to the examples that serve as models for the theory. (NCTM 1.5.2, 1.5.11)**
* **To prove, without help, theorems from the homework indicating an understanding of the relevant concepts and an ability to reason and to express this reasoning process in a manner that cannot be misinterpreted. (NCTM 1.5.1, 1.5.8, 1.5.9, 1.5.14)**

 Remark:  This is a course in communication.  The definitions are paramount.

**POLICIES:**

**HOMEWORK: A large percentage of your grade is determined by your special problem grade.  This requirement will be discussed in detail during the first class.  The goal of the course is twofold.  There is specific content that must be learned and learning this content begins with the definitions.  We also want you to learn how to prove theorems on your own.  This can be a slow process, but you must try in order to ever be successful.**

* + **Homework (Special Problems) must be handed in on 8 1/2 by 11 inch paper.**
  + **Homework (SP) must be entirely your own work.**
  + **Note that not all SP are “hard”. You should at least consider each problem.**
  + **Homework must be neat and well organized.  You should use proper notation and complete sentences. Your logic must be correct.**
  + **There will be two grades recorded for special problems during the course of the semester. 75 points per assignment. 1st grade covers chapters 1- 6 and the 2nd grade covers the rest. The first 15 problems you accomplished successfully during each half of the semester counts 4 points each. The next 15 problems accomplished successfully count 2 points each and then each successful special problems count 1 point after that. So if you accomplish 40 problems successfully in the first half of the semester, your grade on that portion will be 100 points out of 75.**

**CHEATING: Cheating on an ordinary in-class test or quiz will result in a zero.  Note: no material stored in your calculator may be used on a test or quiz.**

**Absence Policy: The standard absence policy is given below. This will be adjusted as the semester unfolds due to the uncertainty surrounding the COVID Virus.**

**Absence Policy: To be successful in this course the student should prepare ahead of time to listen to the lecture and then after the lecture he should immediately develop an understanding of the concepts that were presented. If you are absent, this is very difficult to do.**

* **A student returning from an absence is expected to perform that day just as though he was never gone. The student will be expected to take any quiz or test that is given that day, plus he should hand in any work due that day and any work due while he was gone.**
* **The student will make up any work missed before the second class meeting he is back. Tests and quizzes can be made up only if arrangements are made prior to the absence.**
* **Each absence will count up to 2% off your final grade (even if a university approved absence) if arrangements are not made prior to the absence. Each late is a 1% drop. Please see me immediately after class if you are late. Leaving class early is a 3% drop in grade.**
* **Work missed due to emergencies and illnesses will be handled between the student and the teacher in a timely manner. Students this is also your obligation.**

**Note: There are academic penalties for being late or absent or for leaving early.**

**GRADES**

* + **Scale: Standard 10 point scale – 90 to 100 is an A, 80 to 90 is a B etc with grades rounded up. Hence an 89.5 is an A. All points are equal, there are just more test points, then quiz points, etc.**
  + **Grades will be based upon the following**
    1. **3 Unit tests(including the final) 100 points each**
    2. **1 Semester long Theory project 100 points**
    3. **2 Special homework projects: 75 points each**
    4. **Regular homework: 10 points per chapter**
    5. **Chapter Quizzes:**

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**MA.402: ABSTRACT ALGEBRA ASSIGNMENT SHEET – For 8th Edition**

The following assignment sheet is an ***approximation*** of our schedule.  We may get ahead or behind.  **ADJUST.**  The discussion in class will indicate where we are on the schedule.  Ask each day what the assignment is for the next period.

|  |  |  |  |
| --- | --- | --- | --- |
| **Day** | **Date** | **Discussion** | **Assignment** |
|  |  | **Theory Project** | **Meets AS and math assessment for accreditation.** |
| **1** |  | **Chapters 0** | **Read Ch 0 by Friday Due problems 2, 3 for Friday** |
| **2** |  | **Chapter 0** | **1. Regular Problems(RP):4, 14, 16, 18, 41, 45, 50(read problem 49 first)**  **2. Special Problems(SP): 11\*, 12\*\* 19, 20\*, 21**  **\* For credit these must be done before I do them in class.**  **\*\* Similar to a quiz question** |
| **3** |  | **Chapter 0** | **Read Ch 1 ahead of time** |
| **4** |  | **Chapter 1: Intro to Groups** | **Regular Problems (RP): Ch 1: 1-13, due problem 12 before 6,7, 8 Problems due next class period** |
| **5** |  | **Chapter 2: Groups** | **1. Read Ch 2 ahead of time 2. Example 9 is an important example. It is a main reason we do not require commutativity. Can you give another example of a non-commutative group?** |
| **6** |  | **Groups Properties** | **RP Ch 2: 1,3,4,5,6,7, 9,11,12(not a-1ba ≠ b ↔ ba ≠ ab so think nonabelian), 13,26,32** |
| **7** |  | **1. Order of an element. 2. Subgroups** | **SP Ch 2: 16,19,20,22,24,28,30,31,33,34,38, 48, 50 (13 total)** |
| **8** |  | **Finish Chapter 2** | **1. Ch 2 RP problems due**  **2. Read Chapter 3** |
| **9** |  | **Chap. 3: Finite Groups** | **1. Quiz Chapter 2,**  **2. RP Ch 3:1,2,5,6,7,11,12,14,16,23,24,28,36,37,40,47** |
| **10** |  | **Finish chapter 3** | **1. Chapter 2 SP due 2. Ch 3 SP: 4,18,20,22,26,30,32,38,42,44,52,58,60,62,64 (15 total) 3. Read Chapter 4** |
| **11** |  | **Chapter 4: Cyclic Groups** | **1. Quiz of Chapter 3, Chapter 3 RP due 2. Ch4:  RP: 1,2,4,7,8,10,12,16,17,25** |
| **12** |  | **Cyclic Groups** | **1. Chapter 3 SP due 2. Ch4: SP: 14,20,22,24,30,38,58,60,63,64,66,72,74 (13 total)** |
| **13** |  | **Fund. Thm. Of Cyclic Groups** |  |
| **14** |  | **Review and Catchup** |  |
| **15** |  | **Problems and Catchup** | **Prepare for Test, Turn in SP for chapter 4** |
| **16** |  | **Test Chapter 1 – 4** | **Read Chapter 5** |
| **17** |  | **Chapter 5: Permutations** | **1. Ch 5 RP: 1,2,3,7,10,11,14,16,19,21,22** |
| **18** |  | **Cycle Notation/Properites** | **2. Ch 5 SP: 12,13,26,32,35,36,38,40,42,52,62,70,72,76,82 (15 total)** |
| **19** |  | **Automorphims/ Catchup** | **Read Chapter 6** |
| **20** |  | **Chapter 6: Isomorphisms** | **Quiz Chapter 5, Turn in RP for chapter 5** |
| **21** |  | **Catch up** | **1. Turn in SP for Chapter 5 2. Ch 6 RP:1,2,3,5,20,23,31,32,30,44,54** |
| **22** |  | **Cayley's theorem** | **Ch 6 SP: 6,10,15,16,26,28,34,38,42,48,52,55**  **(12 total) This is the last SP assignment for the first half of the semester.** |
| **23** |  | **Automorphisms** | **Read Ch 7** |
| **24** |  | **Chapter 7: Cosets** | **1. Quiz Chapter 6 2. Turn in Chapter 6 RP’s 3. CH 7 RP: 1,2,3,4,6,9,10,15,17, 18, 23,27,29, 33, 34,45** |
| **25** |  | **Lagrange's Theorem** | **1. Turn in Chapter 6 SP’s 2. Ch 7 SP: 8,11,12,14,16,22,26,28,37,43,46,60 (12 total)** |
| **26** |  | **Finish Chapter 7/Catchup** | **Read Chapter 8** |
| **27** |  | **Chap. 8: External Direct Products** | **1. Quiz Chapter 7 2. 2. Ch 8 RP: Do as many odd problems as you please. Odd problems have answers in the back so attempt before looking. If you disagree with the back of book, do not change your answer and just copy the back of the book. 1 point each. Possible of 45 points out of 10.** |
| **28** |  | **Finish Chapter 8** | **Ch8 SP:4,8,14,16,18,20,22,24,26,28,30,34,38,64,66,68,70,74,76 (19 total)** |
| **29** |  | **Review for Test** | **Prepared for Test** |
| **30** |  | **Test: Chapters 5 – 8** | **Read Chapter 9** |
| **31-32** |  | **Chapter 9: Normal Subgroups** | **1.Chapter 8 sp due 2. Ch 9 RP:ex 1,2,4,7,9,11,13,18,20, and others as you like**  **3. Ch 9 SP 6,8,12,14,16,22,30.32,38,44,48,54,64,68 (13 total)** |
| **33** |  | **Review/ Catchup** | **Read Chapter 10** |
| **34** |  | **Chapter 10: Homomorphism** | **1. Quiz Chapter 9 2. Chapter 9 RP due. 3. Ch 10 SP: 6,8,16,18,20,22,23,24,25,26,28,30,32,34,36,37,39,40, 44, 48, 52,56 (22 total)** |
| **35** |  | **Kernals and Properties** |  |
| **36** |  | **Isomorphisms** |  |
| **37** |  | **Review Chapter 10** | **Read Chapter 11** |
| **38** |  | **Chapter 11.1 The Fund Theroem.** | **1. Chapter 10 quiz 2. Chapter 10 SP due 3. Ch 11 RP: 1, 3, 10, 13, 16 abc, 21, 27** |
| **39** |  | **Proof of Fund Thoerem** | **Ch 11 SP: 4, 5, 6, 12, 14, 22, 26, 30 (8 total) (74 total SP’s 2nd half)** |
| **40** |  | **Review/Catchup** |  |
| **41** |  | **Finish Chapter 11/Review for Final** | **1. Chapter wide take-home due Today. 2. Ch 11 SP due day of Final Exam** |