SHAW UNIVERSITY

COURSE OUTLINE

MAT 311 – MODERN ALGEBRA

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Text: Jimmie and Linda Gilbert –Elements of Modern Algebra – Edition V – Brooks/Cole 1999

Program Mission

The mission of the Mathematics Program is to prepare students with the knowledge, skills, and competencies, for employment in fields of work requiring quantitative and problem solving skills, and also to pursue graduate studies in Pure and Applied Mathematics. The mission is also to produce graduates who are equipped with analytical and critical thinking skills to enable them to formulate problems, solve them, and interpret their solutions, and communicate the solution.

Program Goals

The primary goals of the Mathematics unit for this period are as follows:

1. Produce graduates with the mathematical knowledge and competence with computational and quantitative skills to succeed in the field of work requiring quantitative and problem solving skills
2. Produce graduates with the knowledge and competencies to be prepared for graduate studies in Pure and Applied Mathematics and further research
3. To improve the academic performance of students and increase student retention.

Program Learning Outcomes (PLO's)

1.1 Students will be able to draw the graphs of various functions, find their derivatives, integrals, identify some properties of functions, find the maximum and minimum values of functions using algebraic and calculus techniques. They will also be able to use numerical techniques to find definite integrals of functions and apply all these techniques to solve application problems.

1.2 Students will be able to represent a given data in diagrams, find various measures of central tendencies, dispersions, correlation between variables, and other statistical parameters. They will also be able to find probabilities of certain simple and compound events using various techniques of probability using probability distributions. Students will also be able to apply these techniques to solve application problems.

1.3 Students will be able to solve systems of linear equations, find the matrices representing linear transformations, do matrix computations. They will also be able to solve ordinary differential equations both algebraically and numerically. Students will be able to apply these techniques to solve application problems.

2.1 Students will be able to understand the various techniques of proving theorems and will be able to state and prove theorems using definitions and properties.

2.2 Students will be able to use differentiation and integration techniques to solve application problems in optimizing techniques for functions in Business, Economics, Sociology etc, also find areas and volumes of planes and solids using definite integrals, and multiple integrals.

2.3 Students will be able to use eigen values, eigen vectors in solving and predicting long range effects in other areas of study. Students will be able to solve application problems using these techniques.

3.1 Periodic meetings of all the major students with all the math faculty will be arranged to give an opportunity to students and faculty to communicate and exchange ideas to provide the students with what their academic needs are and make their learning experience more enjoyable.

3.2 The advisors will meet with their advisees at least two times a semester to make sure the students are taking the right courses and are in the right track for timely graduation. Also they will address any academic needs the advisees have and make them more comfortable to stay and complete the major program.

3.3 Inform the students of opportunities on Summer Internships and summer Institutes and encourage them to get these experiences and also take them to undergraduate conferences where they can meet other undergraduate math students and exchange ideas and learn about graduate school and research opportunities. Make arrangements for organizing tutoring sessions for students who need help in their class work.

General Description

This is a Junior/Senior level course taken by students majoring in Mathematics and Mathematics Education. This is an abstract mathematics course dealing with Mathematical structures. The pre-requisite for this course is MAT 232-Theory of numbers which is an introductory proof course. This course deals with Set theory, functions and mappings, Groups, Rings, and Fields. This course is used to bridge the gap from manipulative to theoretical mathematics and to prepare secondary school mathematics teachers for their careers.

Student Learning Outcomes (SLO)

At the completion of this course students will be able to	**PLO-s that are linked to the SLO-s**	**Assessment tools for Student learning Outcomes**
Identify a set and its subsets.	2.1	Home work, class presentation, Quizzes, tests, projects
Perform algebraic operations of Union, Intersection, Complements on sets.	2.1	Home work, class presentation, Quizzes, tests, projects
Prove or disprove equality of two sets.	2.1	Home work, class presentation, Quizzes, tests, projects
Find the Cartesian Product of two finite sets.	2.1	Home work, class presentation, Quizzes, tests, projects
Classify mappings as injective, surjective, and bijective maps.	2.1	Home work, class presentation, Quizzes, tests, projects
Find if a binary operation is associative, commutative.	2.1	Home work, class presentation, Quizzes, tests, projects
Find if a binary operation has an identity and if each element has an inverse.	2.1	Home work, class presentation, Quizzes, tests, projects

Find if a relation is an equivalence relation and find the corresponding partition of the set.	2.1	Home work, class presentation, Quizzes, tests, projects
Prove given properties of integers and primes..	2.1	Home work, class presentation, Quizzes, tests, projects
Prove results by mathematical induction.	2.1	Home work, class presentation, Quizzes, tests, projects
Prove divisibility theorems.	2.1	Home work, class presentation, Quizzes, tests, projects
Find gcd of two numbers.	2.1	Home work, class presentation, Quizzes, tests, projects
Identify congruence relations and their equivalence classes.	2.1	Home work, class presentation, Quizzes, tests, projects
Perform algebraic operations modulo n on integers.	2.1	Home work, class presentation, Quizzes, tests, projects
Verify if a set is a group under a given operation.	2.1	Home work, class presentation, Quizzes, tests, projects
Prove or disprove given statements about groups.	2.1	Home work, class presentation, Quizzes, tests, projects
Check if a subset is a subgroup.	2.1	Home work, class presentation, Quizzes, tests, projects
Find if a group is cyclic or not and if cyclic find a generator.	2.1	Home work, class presentation, Quizzes, tests, projects
Find the order of elements in a group.	2.1	Home work, class presentation, Quizzes, tests, projects
Find if two groups are isomorphic or not.	2.1	Home work, class presentation, Quizzes, tests, projects
Write a permutation as a product of cycles, and transpositions.	2.1	Home work, class presentation, Quizzes, tests, projects
Classify even and odd permutations.	2.1	Home work, class presentation, Quizzes, tests, projects
Classify left and right cosets of a group.	2.1	Home work, class presentation, Quizzes, tests, projects
Find if a subgroup is a normal subgroup or not.	2.1	Home work, class presentation, Quizzes, tests, projects
Prove results using Legrange's Theorem.	2.1	Home work, class presentation, Quizzes, tests, projects
Prove statements about normal subgroups.	2.1	Home work, class presentation, Quizzes, tests, projects
Construct Quotient Groups and identify its properties.	2.1	Home work, class presentation, Quizzes, tests, projects
Connect quotient groups and kernels of homomorphisms.	2.1	Home work, class presentation, Quizzes, tests, projects
Identify if a set with given operations is a Ring, Integral domain or a Field.	2.1	Home work, class presentation, Quizzes, tests, projects
Classify properties of the Ring, Field Zn	2.1	Home work, class presentation, Quizzes, tests, projects
Construct the quotient field of an Integral Domain.	2.1	Home work, class presentation, Quizzes, tests, projects
Study examples of Ordered Fields, Polynomial rings.	2.1	Home work, class presentation, Quizzes, tests, projects

Chapter and Topics

Chapter 1 – FUNDAMENTALS – Sets – Mappings – Composite mappings – Binary operations – Matrices – Relations.

Chapter 2 – THE INTEGERS – Postulates for Integers – Mathematical Induction – Divisibility – Prime Factors and Greatest Common Divisors – Congruence – Congruence Classes – Coding Theory – Cryptography .

Chapter 3 – GROUPS – Definition of a Group – Subgroups – Cyclic Groups – Isomorphisms – Homomorphisms.

Chapter 4 – MORE ON GROUPS – Finite Permutation Groups – Cayley's Theorem – Normal Subgroups – Quotient Groups -.

Chapter 5 – RINGS, INTEGRAL DOMAINS, AND FIELDS – Definition of a Ring – Integral Domains and Fields – Field of Quotients – Ordered Integral Domains.

Chapter 7 – REAL AND COMPLEX NUMBERS – Field of Real Numbers – Complex Numbers and Quaternion – Demoivre's Theorem

Chapter 8 – Polynomials – Polynomials over a Ring – Divisibility – Factorization of Polynomials.

Course Evaluation

HW/Quiz/Seminar/Projects (Best 3 Quizzes)	30%
1-hr tests (Best 3)	40%
Comprehensive Final	30%

No Make-ups will be given for any of the above examinations unless there is proof of any extra-ordinary circumstances.
Some time during the course you will be asked to complete a Student Evaluation (on line) of your instructor. You are expected to complete this task. You might get some extra points for the course.

ATTENDANCE & BEHAVIOR POLICY

Students who miss classes are responsible for subject matter covered, any announcements made regarding quiz, test or any other relevant matter, during their absence**.** More than three unexcused absences may result in failure in the course. You are responsible to find out or know about any announcements or the subject matter covered, during your absence.

To enhance the learning atmosphere of the classroom, students are expected to dress and behave in a fashion conducive to learning in the classroom. More specifically, students will refrain from disruptive classroom behavior (**i. e., talking to classmates, disrespectful responses to teacher instructions; swearing; wearing** clothes that impede academic learning such as but not limited to, wearing body-revealing clothing and excessively baggy pants; hats/caps, and/or headdress. No food or drinks will be allowed inside the class room or lab. Students will turn off telephones prior to entering the classroom. Students who exhibit the behaviors described above, or similar behaviors will be immediately dismissed from class at the third documented offense. The student will be readmitted to class only following a decision by the department chair. The student may appeal the decision of the department chair to the Dean of the College offering the course, and, subsequently, to the Office of the Vice President for Academic Affairs, and then to the President of Shaw University. The decision of the President will be final. Failure to follow the procedures herein outlined will result in termination of the appeal, and revert to the decision of the department chair.

Each behavior construed by the teacher/professor as noncontributive to learning will be recorded, properly documented, and appropriately reported to the student and to the chair of the academic department offering the course. The report will be in written form with a copy provided to both the student and the department chair. The faculty member should retain a copy for his/her own records. Additional student behavior codes may be found in Student Affairs.