Course Aim:
This course aims to develop and equip you with the necessary skills for a mathematically related job. You should demonstrate a basic understanding of fundamental mathematical concepts and processes such as formal mathematical proofs. You should also learn the rigorous way to approach mathematical problems and to be familiar with the process of abstracting from examples, as these skills are essential for all future mathematics courses. You should develop critical analytical skills for a career in a mathematical related job. You will acquire the communication skills necessary to communicate technical ideas, both written and verbal, to a broad audience.

Intended Learning Outcomes:
1. Distinguish between the different kinds of mathematical statements.
2. Apply the rules of elementary logic to correctly formulate mathematical arguments.
3. Apply truth tables to decide logical equivalence and the validity of arguments.
4. Differentiate between the different kinds of quantified statements.
5. Decide the truth of quantified statements.
6. Derive the different ways to prove a quantified statement.
7. Apply different proof techniques in various situations, including direct proofs, indirect proofs, proof by cases, proof by contraposition and proof by contradiction.
8. Distinguish between the different proof techniques above and judge when each method is more suitable than another.
9. Explain how to disprove a given mathematical statement.
10. Recall proof by mathematical induction.
11. Give examples of when strong mathematical induction is preferred over the regular form of induction.
12. Employ the use of the Well-ordering principle in problems.
13. Describe the concept of a sequence and distinguish it from a series.
14. Describe the notion of a set and apply the different set operations to reason about them.
15. Apply the algebraic method and the element method to prove statements about sets.
16. Solve problems using the concept of relations and equivalence relations.
17. Describe the equivalence classes of a given equivalence relation.
18. Rediscover functions as relations.
19. Judge when a given function is injective, surjective or bijective.
20. Explain the concept of function composition and inverse.
21. Differentiate natural numbers and other systems of numbers.
22. Perform basic arithmetical operations on complex numbers.
23. Produce the complex roots of a given complex value.
24. Administer the Division and Euclidean algorithms to solve for various quantities such as the greatest common divisor and apply them to linear combinations.
25. Solve simple equations involving modulo arithmetic.
26. Independently describe underlying mathematical concepts and solve related, but not previously encountered problems.
## Course Content:
1. Elementary logic, mathematical statements, quantified statements
2. Sets, operations on sets, Cartesian products, properties of sets
3. Natural numbers, integers, rational numbers, real numbers, complex numbers
4. Relations, equivalence relations, equivalence classes
5. Functions, injective and surjective functions, inverse functions, composition of functions
6. Division algorithm, greatest common divisor, Euclidean algorithm, fundamental theorem of arithmetic, modulo arithmetic

## Reading and References:
**Textbook**

**Reference-book**


---

**School of Physical and Mathematical Sciences**  
**Division of Mathematical Sciences**