# Important Math Topic For Coding (Copied from geeksforgeeks)

# Module 1

## Time Complexity

* + 1. Analysis of Algorithms
    2. Analysis of common loops, recursion
    3. Asymptotic Notation
    4. Space Complexity
    5. Order of Growth

## Basics

* + 1. Arithmetic and Geometric Progressions
    2. Solving First Competitive Programming Problem
    3. Ranges of Input and Output
    4. C++ Tricks for Competitive Programming
    5. Using Typedef and Macros in C++
    6. Sum of first N natural numbers
    7. Sum of squares of first N natural number
    8. Factorial of a Number
    9. Trailing Zeros in Factorial
    10. Maximum Power Dividing Factorial
    11. Practice Problems

## Fibonacci

* + 1. Fibonacci Numbers and Implementation
    2. Properties of Fibonacci Numbers
    3. Fibonacci Divisibility and GCD
    4. Duddeney's Cow
    5. Count Binary Strings With No two consecutive 1's
    6. Count ways to reach n-th stair
    7. Sum of Fibonacci and of Fibonacci Squares
    8. Fibonacci Log N Implementation
    9. Pisano's Period
    10. Fibonacci Mod M
    11. Practice Problems

## Bit Masking

* + 1. Bitwise OR, AND, XOR
    2. Bitwise Tricks
    3. Count Set Bit
    4. Check Kth bit is set or not
    5. Power of 2
    6. One odd Occurring

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| vii. | Two Odd Occurring |
| viii. | Gray Code |
| ix. | Power Set Using Bitwise |
| x. | Practice Problems |

# Module 2

## Prime Numbers

* 1. Prime Number and Concept
  2. Sieve of Erathoneses
  3. Segmented Sieve
  4. Practice Problems

## Prime Factorization

* 1. All prime factors of a number
  2. Least Prime factor concept
  3. Prime factors for multiple queries
  4. Practice Problems

## DIvisors

* 1. O(sqrt(N)) approach
  2. Count Divisors
  3. Numbers with Exactly 3 Divisors
  4. Count Factors for Multiple queries
  5. Sum of Divisors and Multiple Queries
  6. Practice Problems

# Module 3

## GCD & LCM

* 1. GCD & LCM Concept
  2. Basic & Euclidean Algorithm
  3. Bezout's Identity
  4. Linear Diophantine Equation
  5. Practice Problems

## Number Theoretic Functions

* 1. Euler Totient
  2. Properties of Euler Totient function
  3. Euler Totient for 1 to N
  4. Practice Problems

## Mathematics Principles

* 1. Inclusion & Exclusion Principle
  2. Pigeon Hole Principle
  3. Derangements
  4. Counting Derangements
  5. Subarray sum divisible by Size
  6. Practice Problems

# Module 4

## Modular Operations

* 1. Modular arithmetic Introduction
  2. Modular Arithmetic in Competitive Coding
  3. Range of int Type
  4. Modular Arithmetic Properties
  5. Mod Inverse Concept
  6. Mod Inverse Using Euler's Theorem
  7. Working of Euler's Theorem
  8. Mod Inverse Using Fermat Little
  9. Mod Inverse from 1 to N
  10. Chinese Remainder Theorem
  11. CRT Efficient Implementation

## Modular Exponentiation

* 1. Computing Power
  2. Iterative Power
  3. Matrix Exponentiation
  4. Fibonacci Number using Matrix Exponentiation

## Binomial Concepts

* 1. Permutation
  2. Printing All Permutations
  3. Combination
  4. nCr (Simple)
  5. nCr (recursive)
  6. nCr MOD p for large Prime
  7. Practice Problems

## Catalan Number

* 1. Catalan Number and Concept
  2. Count Way to reach grid top
  3. Number of Binary Trees

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| iv. | Counting Polygon Triangulation |
| v. | More Problems on Catalan |
| vi. | Catalan Number Implementation Based Problems |

# Module 5

## Combinatorial Game Theory

* 1. Introduction
  2. Impartial Game Examples
  3. Grundy Number & its implementation
  4. Mex & Grundy Number
  5. Composites Game
  6. Sprague Grundy Theorem
  7. The Game of Nim
  8. Working of Nim-Sum & Grundy Number Theorem
  9. Practice Problems

## Geometric Algorithms

* 1. Orientation of three ordered points
  2. Line segment Intersection
  3. Convex Hull Problem
  4. Gift Wrapping Algorithm (or Janvi's March)
  5. CPP Implementation of Jarvi's March algorithm
  6. Collinear Points in Jarvi's algorithm
  7. Graham Scan Algorithm for Convex Hull
  8. Graham Scan Algorithm in C++
  9. Closest Pair of Points
  10. Implementation of Closest Pair in C++
  11. Working of Closest Pair Algorithm
  12. Sweep Line Algorithm for Any Two Intersection
  13. Practice Problems.

1. **Misc. Problems**