Online Olympiad Number Theory Classes

Summer 2018

Instructor:	Amir Hossein Parvardi	**Time:**	Monday & Wednesday
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Course pages:

1. Register: `https://parvardi.com/NTclass`
2. Book: `https://topicsinnumbertheory.com`

Main reference:

- Masum Billal and Amir Hossein Parvardi, *Topics in Number Theory: an Olympiad-Oriented Approach*, to be published soon.
- Table of contents: `https://topicsinnumbertheory.com/Contents.pdf`
- Pre-order the book to get a 25% discount, please visit `https://topicsinnumbertheory.com`.

Other helpful resources:

- Dorin Andrica and Titu Andreescu, *Number Theory - Structures, Examples, and Problems*, Springer, 2009.
- Waclaw Sierpinski, *250 Problems in Elementary Number Theory*, Elsevier, 1970.
- Olympiad Archive, AoPS Wiki.

Details: This course is designed to improve students' skills for solving number theory problems in olympiad competitions. The class is provided in two levels.

- **Beginner**: An introduction to number theory. Suitable (mostly) for students in grade 5 to 10, or basically anyone who wants to start studying number theory. I will mainly teach materials in chapters 1 and 2 of the book [TOC] to the students who take this course. For details, see the chourse schedule.
- **Advanced**: Suitable for students who want to compete in serious math olympiads and competitions. I expect most of the students in this class to be in grade 8 to 12, but if you have the prerequisite knowledge for the course, you can join the class no matter what grade you are in. Students in this class will learn the materials presented in chapters $2, 3, 4$ and 5 of the book [TOC]. For details, see the chourse schedule.

Prerequisites:

- **Beginner**: None.
- **Advanced**: Basic divisibility and modular arithmetic, gcd and lcm, bases, and primes.

Grading Policy:

- 80% Homeworks: 5 or 6 in total
- 20% Final exam.

Course Schedule:

Week #	**Beginner Level**	**Advanced Level**
Week 1 **July 30, August 1**	Divisibility, gcd and lcm $(1.1 - 1.2)$	*Review*: Divisibility, gcd and lcm $(1.1 - 1.2)$, Primes $(4.1 - 4.3)$, Bases (1.3), Basic Arithmetic Functions $(3.1, 3.2)$
Week 2 **August 6 & 8**	Floor and Ceiling Function (3.2), Primes and Prime Factorization $(4.1 - 4.3)$	Basic Modular Arithmetic $(2.1, 2.2)$, Residue Systems and Bézout's Lemma $(2.3,\ 2.4)$, Wilson, Euler, and Fermat Theorems $(2.6, 2.7)$
Week 3 **August 13 & 15**	Numeral Systems and Bases and Number of Digits (1.3), Basic Arithmetic Functions $(3.1, 3.2)$	Chinese Remainder Theorem (2.5), Quadratic Residues (2.8)
Week 4 **August 20 & 22**	Basic Modular Arithmetic and Calculations $(2.1, 2.2)$, Bézout's Lemma (2.4)	Wolstenholme's, Lucas', and Lagrange's Theorem, Order and Primitive Roots $(2.9 - 2.12)$
Week 5 **August 27 & 29**	Chinese Remainder Theorem (2.5), Wilson's Theorem (2.6)	Advanced Techniques: Thue's Lemma, Chicken McNugget Theorem, LTE, Vieta Jumping $5.1 - 5.6$
Week 6 **September 10 & 12**	Fermat's and Euler's Theorems, Quadratic Residues $(2.7, 2.8)$ + Problem Solving	Common Arithmetic Functions, Multiplicative Functions and Dirichlet Profuct $(3.3 - 3.5)$
Week 7 **September 17 & 19**	Brief Discussion of Wolstenholme's, Lucas', and Lagrange's Theorem $(2.9 - 2.11)$, Order and Primitive Roots (2.12)	Infinitude of Primes and Bertrand's Postulate $(4.1 - 4.4)$, Zsigmondy's Theorem (5.7), Matrices (5.8) + Problem Solving
Week 8 **September 24 & 26**	Intro to Diophantine Equations 2.15, Pseudoprimes 2.14 + Final Exam	Diophantine Equations + Final Exam