

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY  
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

|                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                          |                        |                                         |   |                                              |   |
|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------------------------|---|----------------------------------------------|---|
| Course Code                                                              |                                                                                                                                                                                                                                                                                                                                                                                                          | Course Title           | Additive Number Theory                  |   |                                              |   |
| Dept. /Faculty proposing the course                                      | SH / Dr. Jagannath Bhanja                                                                                                                                                                                                                                                                                                                                                                                | Structure (LTPC)       | L                                       | T | P                                            | C |
|                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                          |                        | 3                                       | 1 | 0                                            | 4 |
| To be offered for                                                        | PG/PhD                                                                                                                                                                                                                                                                                                                                                                                                   | Type                   | Core <input type="checkbox"/>           |   | Elective <input checked="" type="checkbox"/> |   |
|                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                          | Status                 | New <input checked="" type="checkbox"/> |   | Modification <input type="checkbox"/>        |   |
| Pre-requisite                                                            | CoT                                                                                                                                                                                                                                                                                                                                                                                                      | Submitted for approval |                                         |   | Senate # 63                                  |   |
| Learning Objectives                                                      | <ul style="list-style-type: none"><li>To develop a strong foundational understanding of additive number theory.</li><li>To provide exposure to a variety of research problems and methodologies in additive number theory.</li></ul>                                                                                                                                                                     |                        |                                         |   |                                              |   |
| Learning Outcomes                                                        | <ul style="list-style-type: none"><li>The course will prepare the students to read research papers in Additive Number Theory.</li><li>Students can apply the techniques learned from this course to solve research problems in Additive Number Theory and related areas.</li></ul>                                                                                                                       |                        |                                         |   |                                              |   |
| Contents of the course<br>(With approximate break-up of hours for L/T/P) | Sumsets of integer sets - Sumsets, Direct and inverse problems, Freiman's inverse theorems, Application to the Erdős-Szemerédi conjecture, Nathanson's fundamental theorem. (L7+T2)                                                                                                                                                                                                                      |                        |                                         |   |                                              |   |
|                                                                          | Sumsets in cyclic groups - Cauchy-Davenport theorem, Pollard's theorem, Erdős-Ginzburg-Ziv theorem, Chevalley-Waring theorem, Vosper's theorem, Freiman-Vosper theorem. (L6+T2)                                                                                                                                                                                                                          |                        |                                         |   |                                              |   |
|                                                                          | Sumsets in abelian groups - Kneser's addition theorem and its applications, Rectification principle, Kemperman's theorem. (L6+T2)                                                                                                                                                                                                                                                                        |                        |                                         |   |                                              |   |
|                                                                          | Restricted sumsets - Direct and inverse problems for restricted sumsets, Erdős-Heilbronn conjecture, Dias da Silva-Hamidoune theorem, Alon's combinatorial nullstellensatz, The polynomial method, Kemnitz's conjecture, Freiman-Lev conjecture. (L8+T3)                                                                                                                                                 |                        |                                         |   |                                              |   |
|                                                                          | Growth of sumsets - Doubling constant, Ruzsa distance, Additive energy, Ruzsa's covering lemma, Green-Ruzsa covering lemma, Sidon sets. (L8+T3)                                                                                                                                                                                                                                                          |                        |                                         |   |                                              |   |
|                                                                          | Sumset inequalities - Plunnecke graphs, Magnification ratio, Menger's theorem, Plunnecke-Ruzsa inequality and its applications. (L7+T2)                                                                                                                                                                                                                                                                  |                        |                                         |   |                                              |   |
| Text Books                                                               | <ol style="list-style-type: none"><li>Terrence Tao and Van H. Vu, Additive Combinatorics, Cambridge studies in advanced mathematics, Cambridge University Press, ISBN: 978-0-521-85386-6, 2006.</li><li>Alfred Geroldinger and Imre Z. Ruzsa, Combinatorial Number Theory and Additive Group Theory, Advanced Courses in Mathematics CRM Barcelona, Birkhauser, ISBN: 978-3-7643-8961-1, 2009.</li></ol> |                        |                                         |   |                                              |   |
| Reference Books                                                          | <ol style="list-style-type: none"><li>Melvyn B. Nathanson, Additive Number Theory: Inverse Problems and the Geometry of Sumsets, Springer, ISBN: 0-387-94655-1, 1996.</li><li>Yufei Zhao, Graph Theory and Additive Combinatorics: Exploring Structure and Randomness, Cambridge University Press, ISBN: 978-1-009-31094-9, 2023.</li></ol>                                                              |                        |                                         |   |                                              |   |

Bhanja  
05.06.24