Pre-Ph.D. Course Mathematics

1) Research Methodology (Mathematics) (5 credits) (Compulsory)
   1. LaTeX and Beamer (10 hours)
   2. At least one Mathematical software out of the following: Scilab/KASH/Maxima/SAGE/ Other software suggested by the research guide (10 hours)
   3. Working knowledge of MathSciNet, JSTORE and other online journals, Review of a research paper (4 hours)
   5. Participating in seminar/lecture on different topics in Mathematics (6 hours)

2) ATM School Participation (5 credits) (Optional)
   Advanced Training in Mathematics (ATM) school have been devised by National Board for Higher Mathematics to broaden the knowledge of a research student in Mathematics and also inculcating problem solving skills for better understanding of the subject and developing research orientation. A student participating in an NBHM sponsored ATM school of 3-4 weeks duration such as Annual Foundation School I for II or an Advanced Instructional School on a specific topic will earn 5 credits provided the school is attended after getting provisional admission for Ph.D. The Research Guide will request the coordinator of the school to give a grade to the student based on the participation of the student in the ATM school.

3) Differential Equations (5 credits) (Optional)
   (A) Revision:
      1. Linear system of ordinary differential equation, asymptotic stability, existence uniqueness theorems.
   (B) Classification and Characteristics of Higher Order PDFs: Cauchy-Kovalevskaya Theorem. Holmgren’s Uniqueness Theorem.

Reference Books:

4) **Fourier Series and Functional Analysis (5 Credits) (Optional)**


Reference:

5) **Complex Analysis (5 Credits) (Optional)**

(3) Runge’s theorem, Infinite products, Weierstrass p-function, Mittag-Leffler expansion.

**References:**

6) **Commutative Algebra (5 Credits) (Optional)**

Prime ideals and maximal ideals, Zariski topology, Nil and Jacobson, radicals, Localization of rings and modules, Noetherian rings, Hilbert Basis theorem, modules, primary decomposition, integral dependence, Noether normalization lemma, Krull’s principal ideal
theorem, Hilbert’s Null-stellensatz, Structure of artinian rings, Dedekind domains.
Introduction to Algebraic Number Theory. Discriminants of number field.
Factorisation of ideals. Finiteness of class number. Euclidean number rings.

Text-book:
1. Paul Ribenboim, Algebraic Number Theory.

Additional References:
3. P. Samuel, Algebraic Number Theory.

1) Algebraic Graph Theory (5 Credits) (Optional)
0. Introduction: Graph theory, Linear algebra. Group theory.
4. Automorphisms of graphs: Graph automorphisms, Algorithmic aspects, Automorphisms of typical graphs, permutation groups, Abstract groups, Cayley graphs, Vertex-transitive graphs.

Book : Topics in Algebraic Graph Theory.
Authors : L. W. Beinke and R. J. Wilson
Publisher : Cambridge University Press

8) Course suggested by the Research Guide (5 Credits) (Optional)

There will be a course conducted by the research guide of the Ph.D. student. As per the recommendation of the guide, the student may take a reading course With the guide or one of the optional courses in lieu of it.
9) **If found necessary, course work may be carried out by doctoral**
Candidates in sister Departments/Institutes either within or outside the University for Which
due credit will be given to them. The student.
Can opt for such a course upon recommendation of the Guide and the Chairman,
Ph.D. committee/HOD. Such course-work done outside the department should be restricted
to 10 credit points.

The total number of credits the student should get in the pre-Ph.D. courses is 20.
The credits are distributed as follows:

1. Research Methodology: 5 credits
2. Core Mathematics: 10 credits
   The students should take 2 optional courses of 5 credits each to get 10 credits.
3. Reading course with the Research Guide (or an optional course in lieu of
   it): 5 credits.

**Note:** The above mentioned courses with the given syllabi can also be considered as
M. Phil. courses.