**Shyama Prasad Mukherji College**

**Teaching Plan**

**Course and Year: BSc (H) 2022-23**

**Semester: V**

**Taught individually or shared: Shared**

**Paper: Group Theory II**

**Faculty: Dr. Deepak Bhati & Dr. Kundan Mishra**

**No. of Classes** (per week)**: 5 Lectures + 1 Tutorial**

**Course Objectives:** The course will develop an in-depth understanding of one of the most important branch of the abstract algebra with applications to practical real-world problems. Classification of all finite abelian groups (up to isomorphism) can be done.

**Course Learning Outcomes:** The course shall enable students to:

1. Learn about automorphisms for constructing new groups from the given group.
2. Learn about the fact that external direct product applies to data security and electric circuits.
3. Understand fundamental theorem of finite abelian groups.
4. Be familiar with group actions and conjugacy in S\_3.
5. Understand Sylow theorems and their applications in checking nonsimplicity.

**Teaching Plan**

**Unit – I : Automorphisms and Properties**

Automorphism, Inner automorphism, Automorphism groups, Automorphism groups of finite and infinite cyclic groups, Applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties , Applications of Factor groups to Automorphism groups.

**Unit- II: External and Internal direct product of groups**

External direct products of groups and its Properties , The group of units modulo n as an external direct product, Applications to data security and electric circuits, Internal direct products, Classification of groups of order where p is prime, Fundamental Theorem of finite abelian groups and its isomorphism classes..

**Unit- III: Group Action**

Group actions and permutation representations , Stabilizers and kernels of group actions , Groups acting on themselves by left multiplication and conjugation, Conjugacy in.

**Unit –IV : Sylow theorems and applications**

Conjugacy classes , class equation , p-groups, Sylow’s theorems and consequences, Applications of Sylow theorems, finite simple groups , non simplicity tests, generalized Cayley’s theorem, index theorem, embedding theorem and applications , Simplicity of.

**Teaching Plan**

**Week 1:** Automorphism, inner automorphism, automorphism groups.

**Week 2:** Automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

**Week 3:** Characteristic subgroups, Commutator subgroup and its properties.

**Week 4:** Properties of external direct products, the group of units modulo n as an external direct product.

**Week 5:** Internal direct products, Fundamental Theorem of finite abelian groups.

**Week 6:** Group actions, stabilizers and kernels.

**Week 7:** Permutation representation associated with a given group action.

**Week 8:** Applications of group actions: Generalized Cayley’s theorem, Index theorem.

**Week 9:** Groups acting on themselves by conjugation.

**Week 10:** Class equation and consequences,

**Week 11:** conjugacy in Sn, p-groups.

**Week 12-13 :**  Sylow’s theorems and consequences.

**Week 14:** Cauchy’s theorem, Simplicity of An for n ≥ 5, non-simplicity tests.

**Readings (in APA format)**

**References**

1. **Joseph A. Gallian**, Contemporary Abstract Algebra (4th Ed.), Narosa Publishing House, 1999.
2. **David S. Dummit and Richard M. Foote**, Abstract Algebra (3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd, Singapore, 2004

**Additional readings**

1. **Asha Gauri Shankar , Sudesh Kumari Shah**, Group theory(2012) Pearson education
2. **Vijay K. Khanna and S.K.Bhambri** , A course in abstract algebra (fifth edition), vikas publishing house pvt limited
3. **I.N.Herstein** ,Topics In Algebra, John Wiley and Sons(New York)
4. Schaum’s outline of theory and problems of group theory ,**free ebook , Benjamin Baumslag and Bruce Chandler**
5. Group Theory , **J S Milne** , **free ebook**

**e-references**  [1] Mathematical Science - VLE , University of Delhi.

[2] Paul’s Online Math’s Notes

[3] NPTEL Video Lectures

[4] mathfaculty.fullerton.edu/mathews/n2003/Web

**Methodology of Teaching**:

[1] Using Different software (Mathematica, Latex, R

and MS- Office) and online available Resources.

[2] Visualize the Mathematical Concept by 2D -Imaging

through some software.

[3] Guide, how to read and write research articles and

elaboration of the research papers.

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**ASSESSMENT**

**Tentative date of assessments/ assignments (time frame):**

**Class Test 1 : end of 5th week of Session**

**Class Test 2 : end of 9th week of Session**

**Assignment end of 11th week of Session**

**Class test based on Whole Syllabus on end of 14th week of Session**

**Criteria of Assessment: Class Test, Assignment, Presentation by students, Discussion in class. Viva in the class.**