PHY690J: Group Theory and its application to High Energy Physics
Instructor: Joydeep Chakrabortty

Topics

1. **Discrete and Continuous groups: very brief introduction.**

2. **Lie group :**
   - **(A) Character and Haar measure**
   - **(B) Young Tableux**

(i) **Compact connected groups: U(1), SU(N), Spin(2N), Spin(2N+1),Sp(2N)**
(ii) **Non-compact group: Lorentz group and its characters**

3. **Representation Theory:**
   - **(A) Roots, Weights, Cartan matrix, Dynkin diagrams**
   - **(B) Embeddings and Branching Rules.**
   - **(C) Gauge Theory**

4. **Invariant Polynomial construction: path to Lagrangian**

5. **Grand Unified Theory: through the eyes of representation theory**

6. **Spinors and helicity**

7. **Homotopy theories and topological defects.**

8. **Renormalization Groups and representation theories.**

9. **Anomalies in the context of Global and Gauge symmetries.**

Prerequisites

Quantum Field Theory-I, Basic Mathematical Methods courses.

References

(1) **Rubakov: Classical Theory of Fields.**
(2) **Dixon: A brief Introduction to Modern Amplitude Methods.**
(3) **Slansky: Group Theory for unified model building.**