1. **October 1st 2025**

   Introduction to the course. Fundamental interactions. Evidences of colour quantum number.[1]

   The Action. Hamilton principle. Euler-Lagrangian equations. Noether's Theorem. Noether's currents and conserved charges.[2]

2. **Octoberber 2nd 2025**

   Reminders of Group Theory.

   Representations. Definition of Representation of a group. Reducible and completely reducible representations. Lie Groups and Lie Algebras. Jacobi identity. Classification of Lie Algebras. Simple and semisimple groups and algebras. Compact algebras. SU(N), SO(N), Sp(N): definition and generators. Finite dimensional unitary representations of Lie Groups. Fundamental, Conjugate and Adjoint representations. Casimir Operator.

   Gauge theories. Abelian case: QED. [1]

3. **October 7th 2025**

   Yang - Mills theories [1]. Geometry of gauge invariance [3].

4. **October 9th 2025**

   Definition and properties of the S matrix. [4] Cross section for scattering processes: definition and derivation of the formula. Decay width of a particle.[1] Optical theorem [4].

5. **October 14th 2025**

   LSZ reduction formula [1, 2]. Introduction to the Feynman path integral [2, 1].

6. **October 16th 2024**

   Green's functions and generating functional. Prescriptions for derivation of the Feynman rules.[1]

References

[1] T. Muta,
Foundations of Quantum Chromodynamics, World Scientific.

[2] M.D. Schwartz,
Quantum Field Theory and the Standard Model
Cambridge University Press.

[3] M. E. Peskin and D. V. Schroeder,
An Introduction to quantum field theory, Addison-Wesley publishing Company.

[4] O. Nachtmann,
Elementry particle Physics: Concepts and phenomena
Springer-Verlag.

[5] B. Kayser, https://arxiv.org/abs/hep-ph/9702264