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| **QFT Syllabus** |
| **Review Lagrangian and Hamiltonian formalism :**  |
| 1 | Special relativity, action principle, Noether’s theorem, symmetry, conservation laws |
| **Review quantum mechanics:**  |
| 2 | Schrodinger equation, harmonic oscillator, creation and annihilation operator, Time dependent problems |
| **Relativistic quantum field theory:** |
| 3 | Klein Gordon equation, plane-wave scattering, Dirac field |
| 4 | Dirac field, discrete symmetry(CPT) , Green’s function |
| **Quantization of scalar field:**   |
| 5 | Real and complex scalar fields, canonical quantization, Zero-point energy |
| 6 | propagator, causality |
| **Quantization of Dirac field:** |
| 7 | Anti-commutation relation, causality, helicity |
| **Interacting field and Feynman Diagrams:** |
| 8 | Schrodinger’s picture, Heisenberg’s picture, interaction picture |
| 9 | path integral , perturbation expansion, Wick’s theorem, time-ordered and normal-ordered products |
| 10 | Wick’s theorem, time-ordered and normal-ordered products, Φ4 interaction, one-particle-irreducible, S-matrix |
| 11 | cross section, self-energy |
| **QED at the tree level:** |
| 12 | Quantization of gauge field, Feynman rule, scattering , e+ e-→e+ e-, e+ e-→μ+ μ-, e^+ e^-→2γ |
| 13 | Feynman rule, scattering , e+ e-→e+ e-, e+ e-→μ+ μ-, e^+ e^-→2γ |
| **QED at the one loop level:** |
| 13 | UV divergence in QED, regularization (Dimensional regularization) |
| 14 | electron self-energy, vacuum polarization, Renormalization |
| 15 | optical theorem, Ward identity, Bremsstrahlung, Infrared divergence  |
| 16 | g-2, lamb shift **, Final exam** |