1.	Title of the course	Theory of Atomic Collisions and Spectroscopy
2.	Course number	PH612L
3.	Structure of credits	3-0-0-3
4.	Offered to	PG
5.	New course/modification to	Modification To PH6203/20
6.	To be offered by	Department of Physics
7.	To take effect from	January 2022
8.	Prerequisite	CoT
9.	**Course Objective(s):** To introduce theory of collisions and spectroscopy using advanced relativistic quantum many-body methods. To cover the complementary domains of spectroscopy and collisions, inclusive of the study of resonances resulting from the interference of discrete and continuum states. To underscore the role of symmetry and conservation laws in the study of dynamics of the atom.	
10.	**Course Content:** Differential scattering cross section, partial wave analysis, optical theorem, reciprocity theorem, Levinson's and Seaton's theorems; Time-reversal symmetry in collisions; Anisotropic effects in collisions and photoionization, oscillator strength in different gauges, Lippman-Schwinger scattering, Coulomb scattering, high and low energy approximations to collisions, Born approximation, Breit-Wigner Resonances; Fano parameterization, quantum defect theory, dynamics of time-delay in scattering and photoionization; Many-body theory, cavity quantum electrodynamics, Jaynes-Cummings model, Haroche experiment, Laser cooling, Bose-Einstein condensation, electron gas in Hartree-Fock approximation, Dyson's chronological operator, many-body perturbation theory, Bohm-Pines approach to random phase approximation; 1st, 2nd, higher order Feynman diagrams, relativistic many-body methods, dynamics of confined atoms.	
11.	**Textbook(s):** 1. Friedrich H, *Theoretical Atomic Physics*, 4th Edition, Springer (2017). 2. Johnson W R, *Atomic Structure Theory: Lectures on Atomic Physics*, 1st Edition, Springer (2007).	
12.	**Reference(s):** 1. Burke P G and Joachain C J, *Theory of Electron-Atom Collisions: Part 1: Potential Scattering*, 1st Edition, Springer (2013). 2. Fetter A L and Walecka J D, *Quantum Theory of Many Particle Systems*, 1st Edition, Dover (2003).	