Annexure III

Physics

Paper III

~~PH 804~~ - Hamiltonian Chaos and Semiclassical Mechanics

Unit 1: Dynamics of Differential Equations

Integration of linear second-order equations- Integration of nonlinear second-order equations- Dynamics in the phase plane- Linear stability analysis- Time dependent integrals- Non- autonomous systems.

Unit 2: Hamiltonian Dynamics

Lagrangian formulation of mechanics- Hamiltonian formulation of mechanics- Canonical transformations- Hamilton- Jacobi equations and Action – Angle variables- Integrable Hamiltonians.

Unit 3: Classical Perturbation Theory

Elementary perturbation theory- Canonical perturbation theory- Many degrees of freedom and the problem of small divisors- KAM theorem.

Unit 4: Chaos in Hamiltonian Systems

The surface of section- Area-preserving mappings- Fixed points and Poincaré-Birkhoff Fixed-point theorem- Homoclinic and Heteroclinic points- Criteria for local chaos- Criteria for the onset of widespread chaos- Statistical concepts in strongly chaotic systems- Hamiltonian chaos in fluids.

Unit 5: Semiclassical Mechanics

The connection between Quantum and Classical mechanics -The WKB Method and the Bohr-Sommerfeld quantization condition - Semiclassical quantization for many degrees of freedom - Regular and irregular spectra: Eigenvalue-related properties - Regular and irregular spectra: Eigenvector-related properties - Quantum Maps: Evolution of wave packets - Quantum Maps: Closed-Orbit quantization- The method of Stationary Phase.

References:

1. Michael Tabor, *Chaos, Integrability in Nonlinear Dynamics*, John Wiley & sons, New York
2. Herbert Goldstein, Charles P. Poole, John Safko, *Classical Mechanics*, 3rd edition, Pearson Education, Inc. Delhi, 2002
3. Litchenberg, A. J., and M. A Lieberman, *Regular and Stochastic Motion*, Springer- Verlag, New York, 1983

MS Shaela for Senate approval