MANGALORE UNIVERSITY

Department of Materials Science

MSc Materials Science

MSH 451: **QUANTUM MECHANICS-I** (4 Credits)

Objectives: This course introduces the concept of the language of Physics which makes use of the mathematical tools, learnt earlier, in abundance. As some of the concepts are far removed from the classical picture, they need to be understood well. The use of quantum mechanics to simple to not-so-simple textbook examples/problems is dealt with.

Expected course outcomes: The student should be on the sound footing with the concept of quantum mechanics, its mathematical tools and should develop the ability to apply the concepts and techniques to some known problems.

Unit I

Quantum Physics: Matter waves. Uncertainty principle. Interpretation of the wave particle dualism and complimentarity

Wave Equation and Operators: The Schroedinger equation - free particle in one and three dimensions - the operator correspondence and commutating relations. Normalization of wave functions and statistical interpretation - Box normalization the Dirac delta functions - expectation values - Ehrenfest's theorem. Stationary states - the time independent Schroedinger equation - particle in one dimensional square well potential, potential barriers - transmission and reflection coefficients. 18 hours

Unit II

Eigen values and Eigen functions; One dimensional simple harmonic oscillators - the angular momentum operator - the eigen value equation for the square of the angular momentum - orbital angular and magnetic quantum numbers - the hydrogen atom - solution of the radial equations - Rigid rotator – energy eigen values. 18 hours

Unit-III

General formalism of quantum theory: operator methods**,** Hilbert space and observables, Dirac notation, Schrodinger, Heisenberg and interaction pictures, Simple harmonic oscillator by operator method. Ladder operators, Matrix representations of angular momentum operators, Pauli matrices, Addition of angular momentum, Clebsch-Gordan coefficients. . 18 hours

References

1. Applied X-rays – G W Clark (McGraw Hill, 1955)
2. Quantum Mechanics – L I Schiff (McGraw Hill, 1968)
3. Qauntum Mechanics – Sokolov (Holt Rinehart and Winston Inc., 1966)
4. Quantum Mechanics – Mathews and Venkatesan (Tata McGraw Hill, 1981)

5. Quantum Mechanics – Powel and Craseman (Oxford & IBH, 1985)
6. The Feynman Lectures on Physics, Vol.3- R. P. Feynman, R.B. Leighton and M.Sands**,** Narosa Pub. House(1992).
7. Introduction to Quantum Mechanics- R. L. Liboff, Pearson Education(2003).
8. Introduction to Quantum Mechanics- D J Griffiths, Pearson Education (2005)