

## Approval: 9<sup>th</sup> Senate meeting

<b>Course Name</b>	<b>: Quantum Mechanics II</b>
<b>Course Number</b>	<b>: PH 613</b>
<b>Credits</b>	<b>: 4-0-0-4</b>
<b>Prerequisites</b>	<b>: First course on Quantum Mechanics and faculty consent</b>
<b>Intended for</b>	<b>: UG/PG</b>
<b>Distribution</b>	<b>: Core I-Ph.D./Elective for others</b>
<b>Semester</b>	<b>: Even</b>

**Preamble:** This course introduces some of the advanced level topics on quantum mechanics.

**Course outline:** The course begins a review of some of the basic concepts in quantum mechanics and then discuss the angular momentum algebra. It will then proceed to discuss the concepts in scattering theory, symmetry principles and second quantisation. Relativistic quantum mechanics will be introduced towards the end of the course.

### **Modules:**

1. Review of basic concepts in quantum mechanics, measurements, observables and generalized uncertainty relations, change of basis, generator of translation [10 lectures]
2. General theory of angular momentum, Angular momentum algebra, Addition of angular momenta, Clebsch-Gordon coefficients, Tensor operators, matrix elements of tensor operators, Wigner-Eckart theorem [10]
3. Non-relativistic scattering theory. Scattering amplitude and cross-section. The integral equation for scattering. Born approximation. Partial wave analysis, optical theorem [10]
4. Symmetry principles in quantum mechanics, conservation laws and degeneracies, discrete symmetries, parity and time reversal [6]
5. Systems of identical particles. Symmetric and antisymmetric wavefunctions. Bosons and Fermions. Pauli's exclusion principle. Second quantization, occupation number representation [10]
6. Elements of relativistic quantum mechanics. The Klein-Gordon equation. The Dirac equation. Dirac matrices, spinors. Positive and negative energy solutions, physical interpretation. Nonrelativistic limit of the Dirac equation [8]

### **Text Book:**

1. Advanced Quantum Mechanics, J J Sakurai (Pearson, First edition, 2002)
2. Quantum Mechanics, Cohen-Tannoudji, B Diu, F Laloe (Vol. II) (Wiley, second edition 1977)
3. Quantum mechanics-Landau and Lifshitz (Butterworth-Heinemann Ltd; 3rd Revised edition edition (18 December 1981))
4. Quantum theory of many-particle systems- Fetter and Walecka (Dover Publications Inc2003)
5. Relativistic Quantum Mechanics- Bjorken and Drell (McGraw Hill Education (India))

Private Limited; 1 edition (23 January 2013))

**References:**

1. Quantum Mechanics-Vol.1 and II-Messiah (Dover Publications Inc., 2014)
2. Many-electron theory-S. Raimes (North-Holland Pub. Co.1972)
3. Relativistic Quantum Mechanics-W. Greiner and D. A. Bromley (Springer, 3rd edition , 2000)