Introduction to Quantum Mechanics
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Lecture - 06
Summary of the Course

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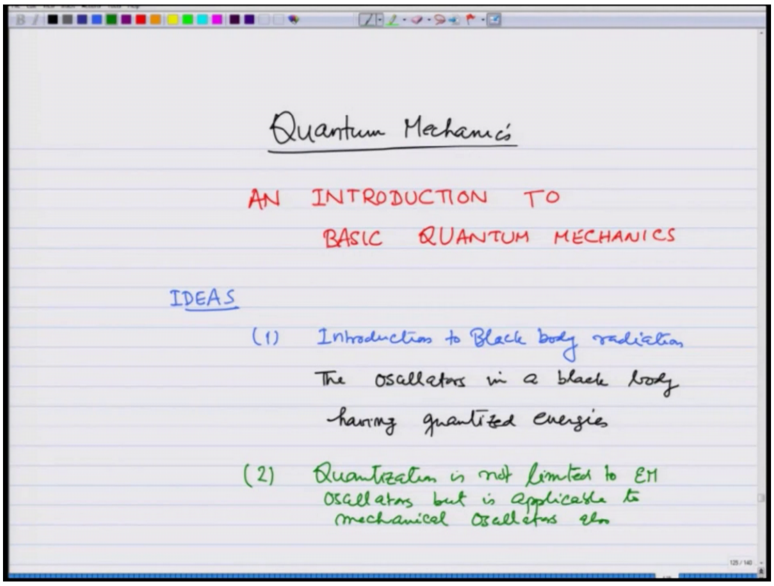

This is the final lecture in this course on quantum mechanics and most of you must have done this for the first time. So, this is really an introduction to basic quantum mechanics what I have tried to do in this course is focus on the ideas. So, we started with how quantum mechanics started.

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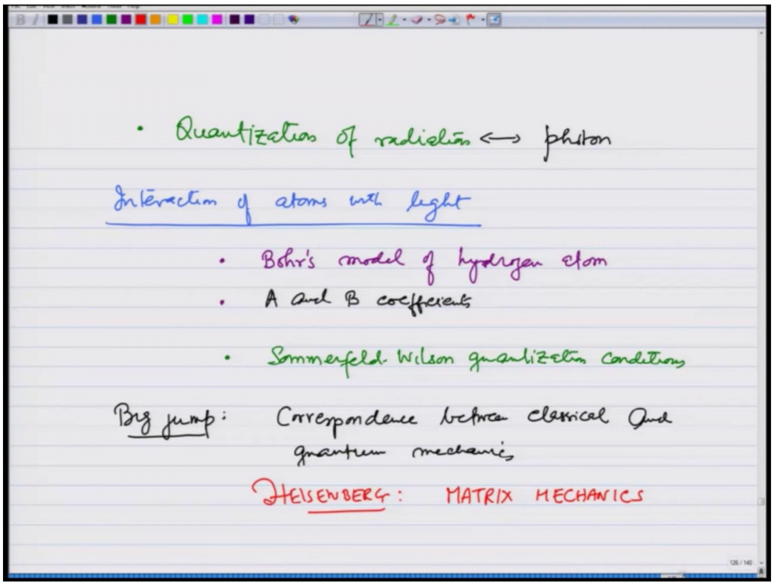

So, first thing that we did was introduction to black body radiation and that led to the oscillators in a black body having quantized energies then we talked about Einstein giving the idea that quantisation is not limited to electromagnetic oscillators, but is applicable to mechanical oscillators also and that gave the correct explanation of the specific heat of solids vanishing as temperature goes towards 0 not only that Einstein also introduced quantization of radiation and gave the concept of photon.

So, this was the beginning of quantum ideas and we look through that and then the next big step came in interaction of atoms with light and what was observed that atoms absorbed certain frequency or gave out certain frequencies and that led to the concept of Bohr's model of hydrogen atom it give the correct frequencies, but one did not know how to calculate the intensities and for that Einstein introduced the ideas of A and B coefficients and said that the interaction is actually probabilistic.

When an atom is going to give away a photon or where is it going to absorb is actually determined by probabilities which are described by a and b coefficients the module given by Bohr's was very limited and further development came by Sommerfeld Wilson quantization conditions and one could solve many systems through this still the whole quantum mechanics was not clear this was Hodge Podge; a combination of classical ideas and quantum ideas.

Then the big jump came after when started exploring the correspondence between classical and quantum mechanics and this was utilised by Heisenberg to give a fully quantum version of mechanics which is known as matrix mechanics; however, matrix mechanics was found to be very difficult to apply to systems which are complicated and not much progress was being made when Schrodinger gave the wave equation for De Broglie waves associated with a moving particle.

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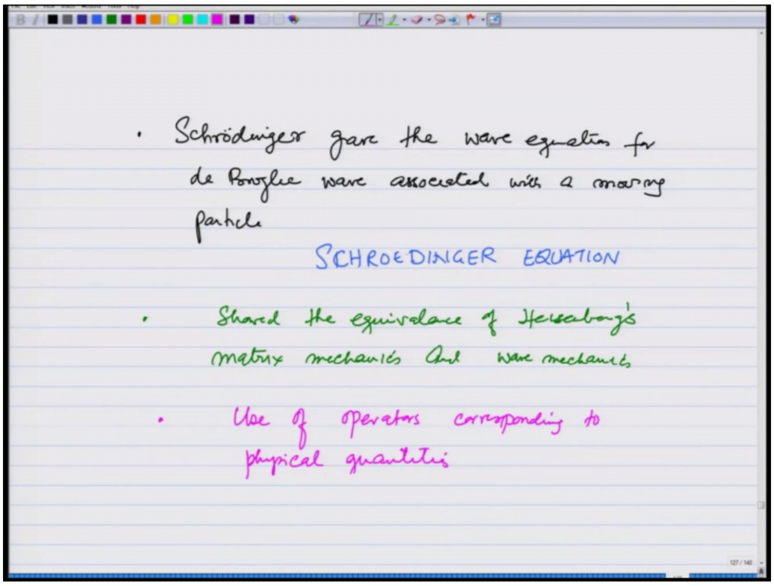

So, what was known as the Schrodinger equation not only Schrodinger gave the equation he also showed the equivalence of Heisenberg’s matrix mechanics and wave mechanics this necessitated the use of operators corresponding to physical quantities.

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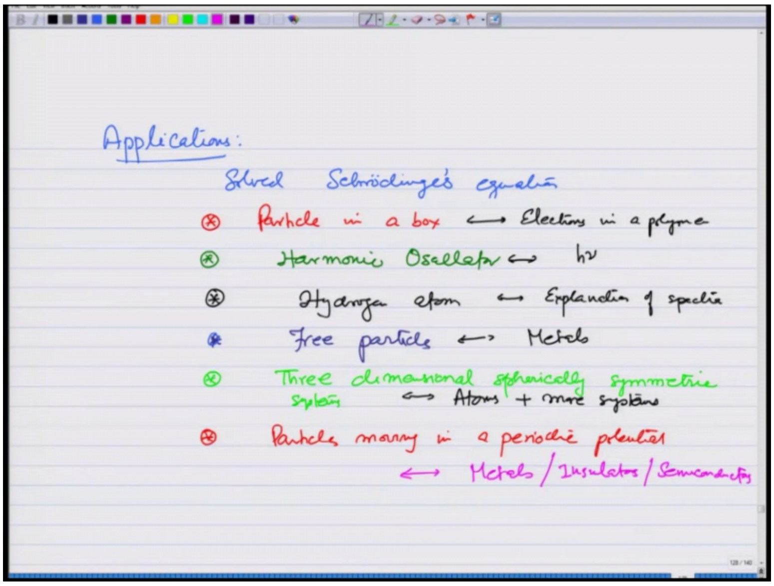

So, this was the time spend in the course in establishing the quantum principles and after that what we did was started applying quantum mechanics and in particular the Schrodinger's equation 2 different systems. So, we solved Schrodinger’s equation for systems like particle in a box harmonic oscillator hydrogen atom then free particles then three dimensional spherically symmetric systems. And finally, to particles moving in a periodic potential each one had a physical counterpart.

So, particle in a box was associated with electrons in a polymer then harmonic oscillator we have all learned that initially harmonic oscillator was quantized to explain black body radiation and also to explain the vanishing of specific heat of solids. So, this has that counterpart hydrogen atom the explanation of spectra.

Then free particles correspond to metals and we introduce the idea of Fermi energy and Fermi wave vector this included atoms and more systems finally, particles moving in a periodic potential correspond to solids metals insulators and semiconductors.

In doing all this, I have restrained myself in that I did not use a lot of mathematics and avoided complicated calculations to convey it you will as simpler way as possible to the ideas behind all these applications of quantum mechanics there is much more to be done.

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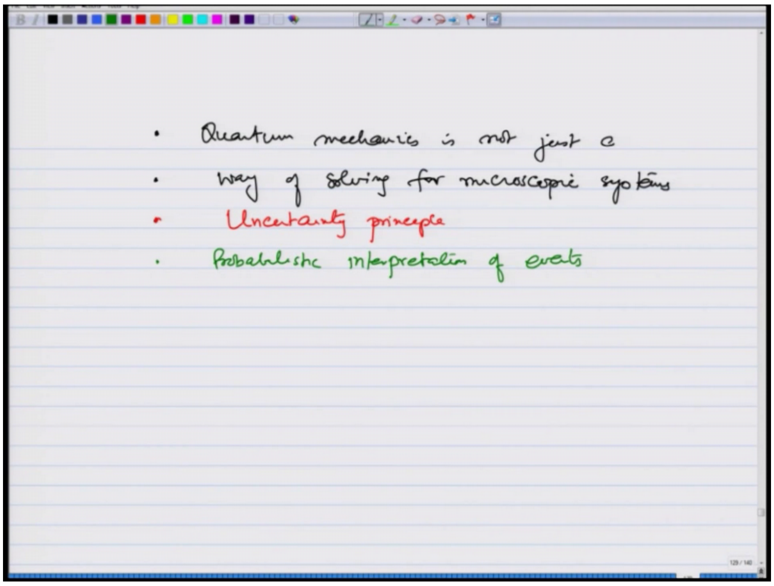

So, if you want to continue in this learning process of quantum you have to take advanced courses and many more topics quantum mechanics is not just a way of solving for microscopic systems, but it has given a lot of fundamental understanding new fundamental understanding. So, in that I will start with uncertainty principle that said that states that we cannot measure certain quantities together with precision which is which can be as small as possible.

Then it gave a probabilistic interpretation of events finding a particle somewhere what is going to be a momentum and so on and now it has changed our thought process to a large extent people are now talking about quantum computers people are now talking about teleportation or you know transporting singles with quantum mechanics there is quantum cryptography.

So, there are lot of applications and what we have done is just touch the tip of the iceberg if you want to progress if you want to learn more you have to take more advanced courses and in a surroundings where lot of this work is being done.

I would also expect you to keep in touch with me or you know with your teachers who teach quantum mechanics if you want to learn more and you are more than welcome to do that. With that we end this course. I hope you have had a good time doing what I set out to teach you.