PHY 3201 Quantum Physics I

Course Description

This course aims to provide an introduction to the basic concepts and principles of quantum theory, and discuss how the theory is used to study various simple physical systems including the hydrogen atom.

Students are advised to take PHY2001, 2002 and 2003 or their equivalents before taking this course. Prerequiste: premission of the instructor.

Course Content

	Topics	**Highlights of Fundamental Concepts**
1.	Particle nature of light	How classical physics fails to explain blackbody radiation, photoelectric effect and Compton effect, and how these phenomena can be explained by developing new ideas and concepts of quantization of energy and wave-particle duality.
2.	Atomic structure and Bohr's model	Problem of classical picture of atoms, atomic spectra and Bohr's model of hydrogen atom, quantization of angular momentum, correspondence principle.
3.	Wave properties of matter	de Broglie's wave, wave packet and uncertainty principle, wave function and its probability interpretation
4.	Basic quantum mechanics	Schrödinger's equation, probability interpretation and conservation, use of Schrödinger's equation to study particle in square wells, tunneling through a barrier, and simple harmonic oscillator, separation of variables and series method in solving differential equations, stationary states, eigenvalues and eigenfunctions, observables and operators, expectation values and uncertainties.
5.	Quantum theory of hydrogen atom	Schrödinger's equation, separation of variables and solution; angular momentum and spherical harmonics, quantum numbers, Zeeman effect, electron spin, anomalous Zeeman effect
6.	Multi-electron atoms	Pauli exclusion principle, electron configurations, periodic table, total angular momentum, LS and jj couplings.
7.	Atomic transitions and radiation	Transitions, spontaneous emission, selection rules, lasers

Learning Outcomes

1.	Students will have a general understanding of how quantum theory was developed, and in particular appreciate how a new theory is developed when an existing theory fails to explain experimental observations.
2.	Students will learn the basic concepts of wave-particle duality, uncertainty principle, and quantization of energy in quantum physics.
3.	Students will learn the key equation in quantum physics, the Schrödinger equation, and how to solve it for various physical problems.
4.	Students will learn how to approach and tackle a given problem and apply the mathematical and analytical skills in solving the problem.

Learning Activities

Lecture		Tutorial		Exercise Class and Assignment		Laboratory		Project / Report		Presentation		Case study		Web teaching		Other 1 (specify)		Other 2 (specify)	
(hr / week)		(hr / week)		(hr / week)		(hr / week)		(hr in total)		(hr in total)		(hr in total)		(hr / week)		(hr in total)		(hr in total)	
in class	out class	in class	out class	in class	out class	in class	out class	in class	out class	in class	out class	in class	out class	in class	out class	in class	out class	in class	out class
4	6			0.75	3														
M	M	NA	NA	M	M	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

M: Mandatory activity in the course O: Optional activity NA: Not applicable

Assessment Scheme

	Component	**Description**	**Weight**
1.	Homework	About 10 homework sets will be given. The homework problems supplement discussions in class, and allow students to consolidate what they have learned during classes and practice their problem-solving and mathematical skills.	20%
2.	Mid-term Test	The mid-term test will be held in class.	30%
3.	Final Examination	The final examination will be centrally arranged by the university.	50%

Learning Resources

	Resource	Web link or ref no. in library
1.	R A Serway, C J Moses and C A Moyer, “Modern Physics”, 2nd ed, Saunders College Publishing, 1997	110.32
2.	J R Taylor, C D Zafiratos and M.A. Dubson, “Modern Physics for Scientists and Engineers”, Prentice-Hall, 2nd ed. 2004	QC21.2.T39 2004
3.	S Gasiorowicz, "Quantum Physics", 2nd Ed. (John Wiley & Sons 1996).	110.47
4.	A Beiser, “Concepts of Modern Physics”, 5th ed, McGraw-Hill, 1995	QC21.2.B448 1995
5.	K Krane, “Modern Physics”, 2nd ed,Wiley, 1996	QC21.2 .K7 1996
6.	H C Ohanian, “Modern Physics”, 2nd ed, Prentice-Hall, 1995	QC21.2.O36 1995
7.	L Lyons, "All you wanted to know about Mathematics but were afraid to ask --- Mathematics for science students", Vols. 1 and 2 (Oxford University Press 1995).	QA39.2.L97 1995 v.1 QA39.2.L97 1995 v.2

Feedback for Evaluation

1.	Contact the teacher in person or send her an email, especially for issues that require immediate action.
2.	Post a message on the forum of the course website.
3.	Express your views (or ask a student representative to help you convey the messages) in the staff-student consultation meeting held every year.
4.	Express your views in the term-end course evaluation.

Course Schedule

	Topics	**Week No.**	**Activities / Readings / References**
1.	Particle nature of light	1-2	
2.	Atomic structure and Bohr’s model	3	
3.	Wave properties of matter	4	
4.	Basic quantum mechanics	5-7	
5.	Quantum theory of hydrogen atom	7-9	
6.	Multi-electron atoms	10-11	
7.	Atomic transitions and radiation	12-13	

Teachers' or TAs' Contact Details

Teacher's Name	Contact	Additional Information
CHING Shuk Chi Emily Teacher	Office : SC 344 Tel. no. : 2609 6305 Email : ching@phy.cuhk.edu.hk	Consultation Hour: To be announced in the first lecture or by appointment via email.
TAs's Names	**Contact**	**Additional Information**
To be arranged		

Academic Honesty and Plagiarism

Attention is drawn to University policy and regulations on honesty in academic work, and to the disciplinary guidelines and procedures applicable to breaches of such policy and regulations. Details can be found at http://www.cuhk.edu.hk/policy/academichonesty/.

1.	After the course registration, you are required to submit "Declaration of Honesty in Academic Work" declaring that you are aware of these policies, regulations and procedures. The form can be found at http://www.phy.cuhk.edu.hk/

Facilities for Posting Announcements and Materials

1.	The course website (http://www.phy.cuhk.edu.hk/course/2009-2010/1/phy3201) contains the following useful information and resources: (a) All course materials, including lecture notes, homework sets and solutions. The password for download will be given to you in the first lecture. (b) A notice board for announcements of assignments, latest download, and important events (e.g. examination schedule). (c) A web forum for you to ask questions, discuss problems with teachers and classmates. You are also welcome to express your comments on the course in the forum.