FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science *(Degree/ Honors)*	Semester: V	Session: 2024-25

1	Course Code	**PHSC-05T**
2	Course Title	**Introduction to Quantum Mechanics**
3	Course Type	**Discipline Specific Course**
4	Pre-requisite (if any)	**As per Program**
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ Explain the basic postulates of quantum mechanics ➢ Explain the concept of the wave packet ➢ Describe the principle of Heisenberg's uncertainty principle and its applications ➢ Gain knowledge about physical quantities as operators ➢ Apply the Schrodinger equation to various quantum systems
6	Credit Value	**03 Credits** | **1 Credit = 15 Hours - Learning & Observation**
7	Total Marks	**Maximum Marks: 100** | **Minimum Pass Marks: 40**

PART – B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 45 Periods (45 Hours)

Unit	Topics	No. of Period
I	**Wave-particle duality:** Limits of classical mechanics, Theoretical and experimental consequences and their explanation such as black body radiation, Planck's law, Photoelectric effect, Compton's effect, Specific heat of solids at low temperatures, wave-particle duality and demonstration of matter waves, Bohr's complementary principle and correspondence principle, Concept of the wave packet and its spread with time, Gaussian wave packet, Phase and Group velocity, de-Broglie wavelength using phase velocity and group velocity.	12
II	**Uncertainty principle:** Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables), Experiments for the verification of uncertainty principle, mathematical derivation of uncertainty principle for the one-dimensional wave packet, Applications and consequences of the uncertainty principle.	10
III	**Schrodinger equation:** Representation of dynamic variables by operators (operators for the position, momentum, energy, angular momentum), Schrodinger's wave equation, Wave function, Probabilistic interpretation of wave function, Probability current densities in one dimension, Equation of continuity, Normalization of wave function, Orthogonality property of wave function, Expectation value of dynamical variables, Ehrenfest's theorem, Postulates of Quantum Mechanics.	11
IV	**Application of Schrodinger wave-equation** Solution for free particle, Free particle in a box and density of states, Transmission through potential step, Rectangular potential barrier and tunnelling phenomena, Linear harmonic oscillator with the concept of zero-point energy and parity, Schrodinger equation in spherical polar co-ordinates, spherical symmetric potential, energy states of hydrogen using Schrodinger equation.	12

Keywords:	Black body radiation, Planck's, Photoelectric effect, de-Broglie wavelength, Uncertainty principle, Schrodinger equation.

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Signature of Convener & Members (CBoS):

PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books *Recommended*

1. Unified Physics- III, R. P. Goyal, Shivlal Agrawal Publications
2. Unified Physics- III, Navbodh Publications

Reference Books*Recommended*

1. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
2. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill
3. Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan

Online Resources (e-books/ learning portals/ other e-resources)

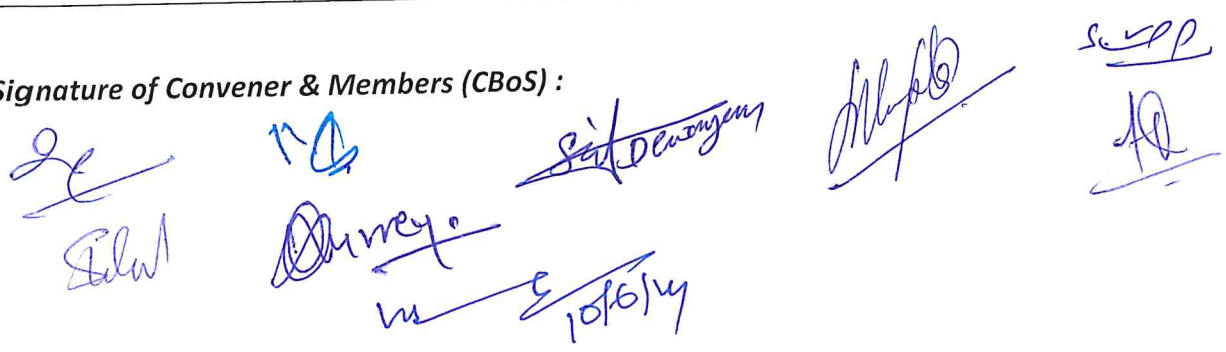
1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics textbook in PDFhttps://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. Cambridge University Books for Physics https://www.cambridgeindia.org/
4. Books for solving physics problems https://bookboon.com/en/physics-ebooks
5. NPTEL Online courses: https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. Quantum Mechanics https://archive.nptel.ac.in/courses/115/101/115101107/
7. Quantum Mechanics https://nptel.ac.in/courses/115106066

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 100Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Examination (ESE): 70 Marks

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20+20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz + marks obtained in Assignment shall be considered against **30** Marks
End Semester Exam(ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type, **1 out of 2** from each unit- **4x10 =40 Marks**	

Signature of Convener & Members (CBoS) :



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PART – A: INTRODUCTION				
Program : Bachelor in Science (Degree/ Honours)			**Semester: V**	**Session: 2024-25**
1	Course Code	**PHSC- 05 P**		
2	Course Title	**Introduction to Quantum Mechanics**		
3	Course Type	**Discipline Specific Course**		
4	Pre-requisite (if any)	**As per Program**		
5	Course Learning Outcomes (CLO)	After the completion of the course, get opportunity to perform the following experiments on measurement and verification basicconcepts of Quantum mechanics. The studentsare expected to: ➢ Assemble required parts/devices and arrange them to perform experiments. Record/ observe data as required by the experimental objectives. ➢ Analyze recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to laws of Quantum Mechanics and its applications ➢ Apply the learnt concepts for different problems in laser systems, nuclear physics and EMW related problems.		
6	Credit Value	**01 Credit**	**1 Credit = 30 Hours Laboratory Work**	
7	Total Marks	**Maximum Marks: 50**	**Minimum Pass Marks: 20**	

PART – B: CONTENT OF THE COURSE

Total No.of learning-Training/performance Periods - 30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Period
1	Measurement of Planck's constant using black body radiation and photo-detector	30
2	Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light	
3	To determine work function of material of filament of directly heated vacuum diode.	
4	To determine the Planck's constant using LEDs of at least 4 different colours.	
5	To determine the wavelength of H-alpha emission line of Hydrogen atom.	
6	To determine the ionization potential of mercury.	
7	To determine the absorption lines in the rotational spectrum of Iodine vapour.	
8	To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.	
9	To setup the Millikan oil drop apparatus and determine the charge of an electron.	
10	To show the tunneling effect in tunnel diode using I-V characteristics.	

Keywords: Planck's constant, tunneling effect, Photo-electric effect, spectrum –Rotational and vibrational, e/m

Signature of Convener & Members (CBoS) :

10.06.24

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Edn, 2011,Kitab Mahal
4. Practical Physics B. Sc III : R P Goyal, Shivlal Publications

Reference Books Recommended-

1. Practical Physics by Dr. Giasuddin Ahmad and Md. Shahabuddin
2. Practical Physics by Dr. Harnam Singh
3. Practical Physics by R. K. Shukla and N. K.

Online Resources (e-books/ learning portals/ other e-resources)

1. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=195
2. https://mpv-au.vlabs.ac.in/
3. https://mpv-au.vlabs.ac.in/modern-physics/Hall_Effect_Experiment/
4. https://www.falstad.com/qmatomrad/
5. https://www.falstad.com/mathphysics.html : Quantum mechanics

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
End Semester Exam(ESE):35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance – **05** Total Marks - **15**	Better marks out of the two Test / Quiz **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

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