337C5B

COURSE	**FIFTH SEMESTER – CORE COURSE- VI**
COURSETITLE	**RELATIVITY AND QUANTUM MECHANICS**
CREDITS	**4**
COURSE OBJECTIVES	To understand the theory of relativity, its postulates and the consequences.To learn the importance of transformation equations and also to differentiate between special and general theory of relativity.To interpret the wave theory of matter with various theoretical and experimental evidences.To derive and use Schrodinger's wave equation and also learn about various operators. To solve Schrodinger's wave equation for simple problems and analyse to understand the solutions.

UNITS	**COURSE DETAILS**
UNIT-I	**SPECIAL THEORY OF RELATIVITY:** Michelson-Morley Experiment–Frames of Reference – Galilean Relativity – Postulates of Special Theory of Relativity – Lorentz Transformation – Consequences – Time Dilation–Concept of Simultaneity – Doppler Effect – Length Contraction–Variation Of Mass with Velocity – Einstein's Mass-Energy Relation– Relativistic Momentum – Energy Relation
UNIT-II	**TRANSFORMATION RELATIONS:** Transformation of velocity, mass, energy and momentum – four vector – invariance under transformation – Lorentz transformation and velocity addition equations in terms of hyperbolic functions. **GENERAL THEORY OF RELATIVITY:** Inertial and Gravitational mass – Principle of equivalence – Experimental evidences for General theory of Relativity
UNIT-III	**PHOTONS AND MATTER WAVES:** Difficulties of classical physics and origin of quantum theory –black body radiation – Planck's law – Einstein's photoelectric equation – Compton effect –pair production – De Broglie waves – phase velocity and group velocity– Davisson and Germer's experiment –uncertainty principle – consequences –illustration of Gamma ray microscope.
UNIT-IV	**OPERATORS AND SCHRÖDINGER EQUATION:** postulates of quantum mechanics – Wave function and its interpretation – Schrödinger's equation – linear operators – Eigenvalue – Hermitian operator – properties of Hermitian operator– observable – operators for position, linear Momentum, angular momentum components – commutator algebra –commutator between these operators –expectation values of position and momentum – Ehrenfest theorem.

UNIT-V	**SOLVING SCHRÖDINGER EQUATION FOR SIMPLE PROBLEMS:** one-dimensional problems: (i) particle in a box, (ii) barrier penetration problem – quantum mechanical tunneling, (iii) linear harmonic oscillator. higher dimensional problems: (i) Rigid rotator (qualitative), (ii) Hydrogen atom (qualitative).
TEXT BOOKS	1. Special Theory of Relativity,S. P. Puri, Pearson Education, India, 2013. 2. Concepts of Modern Physics, A.Beiser, 6th Ed., McGraw-Hill, 2003. 3. Modern Physics, R. Murugeshan, KiruthigaSivaprasath,S. Chand & Co.,17th Revised Edition, 2014. 4. Quantum Mechanics, S.P.Singh, M.K.Bagde, S.Chand& Co., New Delhi, 2000. 5. Quantum Mechanics in Physics and Chemistry with Applications to Biology,RabiMajumdar, PHI, 2011. 6. Modern Physics, R. Murugesan, S.Chand& Co., New Delhi. (Quantum Mechanics,Gupta, Kumar and Sharma. Jai PrakashNath&Co Meerut 7. Quantum mechanics – Satyaprakash and Swati Saluja. KedarNath Ram Nath& Co.
REFERENCE BOOKS	1. Fundamentals of Modern Physics, Peter J. Nolan, 1stEdition, 2014, byPhysics 2. QuantumMechanics,V.Murugan, PearsonEducation, India, 2014. 3. QuantumMechanics, Alastair I. M. Rae and JimNapolitano, 6th Edition, CRC Press:Taylor& Francis, 2010. 4. QuantumPhysics:A FundamentalApproachto Modern Physics, John S. Townsend, UniversityScience Books, Sausalito, California, 2010. 5. QuantumMechanics: Theoryand Applications, AjoyGhatak and S. Lokanathan, Springer ScienceBusiness Media, Dordrecht, Netherlands, 2004. 6. Physics ofthe Atom,Editor(s): M. R. Wehr, J. A. Richards, T. W. Adair, 4th Edition, Narosa, 2013. 7. QuantumMechanics, V.Devanathan, Narosa Pub. House, Chennai, 2005. 8. QuantumMechanics, V.K. Thangappan, New Age International, New Delhi. 9. AText Book of QuantumMechanics, Mathews &Venkatesan, Tata McGraw Hill, New Delhi. 10. QuantumMechanics, Ghatak&Loganathan, Macmillan Publications. 11. Introductionto QuantumMechanics, Pauling &Wilson, McGraw Hill Co., NewYork. 12. QuantumMechanics, Gupta, Kumar and Sharma. JaiPrakashNath&Co Meerut

WEBLINKS	1. http://hyperphysics.phy-astr.gsu.edu/hbase/qapp.html 2. https://swayam.gov.in/nd2_arp19_ap83/preview 3. https://swayam.gov.in/nd1_noc20_ph05/preview 4. https://www.khanacademy.org/science/physics/special-relativity/minkowski-spacetime/v/introduction-to-special- relativity-and-minkowski-spacetime-diagrams

COURSE OUTCOMES:

At the end of the course,the student will be able to:

COURSE OUTCOMES	**CO1**	Understand various postulates of special theory of relativity.
	CO2	**Appreciate the importance of transformation equations and also the general theory of relativity..**
	CO3	Realise the wave nature of matter and understand its importance
	CO4	Derive Schrodinger equation and also realize the use of operators.
	CO5	Apply Schrödinger equation to simple problems.

MAPPING WITH PROGRAM OUT COMES:

Map course outcomes**(CO)** for each course with program outcomes**(PO)** inthe3- point scale of STRONG(**S**),MEDIUM(**M**)andLOW(**L**).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	M	S	M	M	S	M	M	M
CO3	M	M	S	M	S	S	M	S	S	S
CO4	M	S	S	S	S	S	S	M	M	M
CO5	S	M	S	S	M	M	S	M	M	S