

CBCS-2019

Distribution of Credits for M. Sc. Physics Sem. – II

(Effective from 2021-22 to ...)

Sr. No	Course code	Title of courses	Credit
1	PHY2201C07	MATHEMATICAL PHYSICS II	3
2	PHY2202C08	QUANTUM MECHANICS	4
3	PHY2204C09	NUCLEAR PHYSICS	4
4	PHY2208C10	CONDENSED MATTER PHYSICS	4
5	PHY2203C22	COMPUTATIONAL PHYSICS	2
6	PHY2210C12	PHYSICS LABORATORY-II	8
Total			25

		The Maharaja Sayajirao University of Baroda Faculty/College of << Faculty of Science >>, Department of << Physics >>		ACADEMIC YEAR 2019-2020	
<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>					
YEAR	I	CORE: <<PHY2201C07>> : << MATHEMATICAL PHYSICS - II >>		CREDIT	3
Semester	II			HOURS	45
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I		<< COMPLEX VARIABLES I >>			15 hrs.
		<<Analytical functions and Cauchy-Riemann conditions, Poles-Taylor and Laurent series, contour integral and Cauchy's representation, Residue theorem, evaluation of residue at n th order pole. Jordan's Lemma Evaluation of definite integral, Principle value of the integral, branch point, branch cut and integration around branch cut.Conformal mapping and its applications.>>			
UNIT-II		<< SPECIAL FUNCTIONS II AND DIFFERENTIAL EQUATIONS >>			15 hrs.
		<<: Spherical harmonics($Y_l^m(\theta, \phi)$) and vector spherical harmonics, Laguerre polynomials, Associated Laguerre polynomials, Bessel function, spherical Bessel function, their properties, Recurrence relations, Orthogonality and Generating functions..>>			
UNIT-III		<< PARTIAL DIFFERENTIAL EQUATIONS >>			15 hrs.
		<<Review of expressions for gradient, divergence, curl and Laplacian operators in generalized co-ordinates. Boundary conditions, Laplace's equation, Heat diffusion equation and wave equation in Physics, Separation of variable technique to solve them, Green's function technique in general and especially for Poisson's equation.>>			
REFERENCES (Text Books)					
1.	Mathematical methods for physicists : G. B. Arfken and H. J. Weber , 5 th edition Academic press/Elsevier science, India 2000.				
2.	Advanced Engineering Mathematics Kreyzing 8 th edition, 2006, John Wiley & Sons (Asia Pvt.), Singapore .				
3.	Mathematical physics P. K. Chattopadhyay: 1990, New age international publisher , New Delhi.				
4.	Mathematical methods for physics and engineering K. F. Riley, M. P. Hobson				
5.	Complex analysis :Churchil				

		The Maharaja Sayajirao University of Baroda Faculty/College of <<Faculty of Science >>, Department of <<Physics >> <<Address>>, <<Contact details>>, <<e-mail ID>>			ACADEMIC YEAR 2019-2020		
<<Name of the Programme: M.Sc.>> : <<M.Sc. Physics >>							
YEAR	I	CORE: <<PHY2202C08>> : <<QUANTUM MECHANICS >>				CREDIT	4
Semester	II					HOURS	60
OBJECTIVES:							
COURSE CONTENT / SYLLABUS							
UNIT-I	<< Vectors, Matirces and Heisenberg mechanics >>					15 hrs.	
	<< Review of different types of matices and matirx algebra, transposition, comlex conjugation and adjoint of matrices, review of determinant and its properties, vectors and vector space, Dirac notations, linearly independent, orthigonal and orthonormal vectors, abstract representation of vectors, inner and outer product of vectors, Gram-Schmidt method of orthogonalization of vectos, Schwarz inequality, linear transformation of vectors, eigenvalues and eigenvectors of a matrix and properties of eigenvalues and eigenvectors, inversion and diagonalization of a matrix- analytical and numerical methods, special type of metrics:- orthogonal, unitary and hermitian mtrices and their properties, diagonalization of hermitian matrix, change of basis and unitary transformations, bi-linear, quardratic and hermitian forms, Cayley-Hamilton theorm, infinite dimensional Hilbert space, basis in Hilbert space, vector representation of a vector and matrix representation of an operator, Schrodinger equation in matrix form, statement of assumptions of Heisenberg quantum mechanics, general uncertainty principle for non-commuting variables. >>						
UNIT-II	<< >>					15 hrs.	
	<<.1-D Harmonic Oscillator: treatment of 1D harmonic oscillator problem with use of operator and matrix formalism. Transformations, conservation laws and Symmetries: Translation in space and conservation of linear momentum, translation in time and conservation of energy, rotation in space, quantum generalization of the rotation operator and conservation of angular momentum, conservation of charge, reflection, parity and space inversion, Time-Reversal operator:- Properties of anti-linear operator, time reversal for spin less particle, time reversal operator for non-zero spin particle. MANY PARTICLES SYSTEMS:Identical particles (fermions/bosons), symmetric and anti-symmetric wave function, multiplicity and degeneracy>>						
UNIT-III	<< >>					15 hrs.	

	<< SCHRODINGER WAVE EQUATION AND ITS EXACT SOLUTION FOR ONE DIMENSION : (Review : admissibility condition for wave functions), observables as dynamical variables and their expressions as Hermitian operator. SCHRODINGER EQUATION IN THREE DIMENSION:Schrodinger equation in three dimensions, spherically symmetric different potentials, angular momentum, commutation amongst L_x, L_y and L_z , eigen value spectrum of L^2 and L_z , Legendre polynomials >>	
UNIT-IV	<<APPROXIMATE METHODS>> <<Time independent perturbation theory for non-degenerate case (1st and 2nd order) and for degenerate case (1st order only), removal of degeneracy, application of perturbation theory, an harmonic oscillator, stack effect, variational method, upper bound to excited states, trial wave function in variational method, WKB approximation, turning point solution, validity, WKB connecting formula, Bohr – Sommerfeld quantum condition, application of variational method and WKB approximation.>>	15 hrs.
REFERENCES (Text Books)		
1.	Quantum mechanics by L P Schiff, McGraw Hill International, 1968.	
2.	Quantum mechanics by J I Powell & B Crasemann 2 nd edition, B. I. Publication, Delhi, 1971.	
3.	Quantum mechanics by Ghatak& Loknathan	
4.	Quantum mechanics G. Aruldas; Prentice-Hall of India Pvt. Ltd. 2002	

.....

		The Maharaja Sayajirao University of Baroda Faculty/College of <<Faculty of Science >>, Department of <<Physics >>			ACADEMIC YEAR 2019-2020	
<<Name of the Programme: M.Sc. : <<M.Sc. Physics >>						
YEAR	I	CORE: <<PHY2204C09>> : <<NUCLEAR PHYSICS>>			CREDIT	4
Semester	II				HOURS	60
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I		<<Interaction of radiation and charged particle with matter>>				15 hrs.
		<<Energy loss of electrons and positrons, Stopping power and range of heavier charged particles, Interaction of gamma rays with matter. Nuclear radiation detectors: Gas filled detectors, Proportional and Geiger Muller counters, Scintillation detector, Solid state detectors.>>				
UNIT-II		<< >>				15 hrs.
		<<Nuclear forces and two body problems: Saturation, Charge independence and Exchange forces, Deuteron ground and excited states, Low energy n-p scattering, Scattering length, Spin dependence of nuclear forces, Effective range theory, Meson theory of nuclear force. Nuclear models :Semi empirical mass formula, Single particle shell model, its validity and limitations, Collective model (Qualitative discussion on rotational and vibrational states). >>				
UNIT-III		<< >>				15 hrs.
		<< Nuclear reactions: Partial wave analysis of nuclear reaction (result only),Single level Briet Wigner formula, Direct reactions, Compound nucleus hypothesis, Resonances in reactions. Reactor Physics:Nuclear chain reaction (four factor formula), Reactor materials, Breeder reactor.>>				
UNIT-IV		<< >>				15 hrs.
		<< Nuclear decay:Fermi theory of β -deacy, Kurie plot, ft- values, allowed and forbidden transition, Fermi and Gamow Teller selection rules, Multipole transition and selection rules. Elementary particles: Fundamental forces and fundamental particles, Symmetries and conservation laws, Space time symmetries, Space inversion, Charge conjugate and time reversal symmetries,CPT theorem and its consequences,Lepton numbers and baryon numbers, Isospin,Strangeness and Charm,Gell-Mann and Nishima relation, Hadronic spectrum and Quark model, Concept of colour and gluons.>>				
REFERENCES (Text Books)						
1.	Atomic and Nuclear Physics – S. N. Ghoshal (Physics Vol.-II) 1 st Edition, 1964, S. Chand Company Ltd, New Delhi.					
2.	Nuclear Physics by Krane.					
3.	Experimental Nuclear Physics by R. M. Singru.					
REFERENCES						
1.	Concept of Nuclear Physics by Cohen.					
2.	Nuclear Physics by Blatt and Weisskopf.					
3.	Physics and Nuclei and Particles by Marimier and Sheldon.					
4.	Nuclear Reaction Detector by Kapoor and Ramamurthy.					
5.	The Atomic Nucleus by R.D. Evans.					
6.	High Energy Physics by Perkins.					
7.	Nuclear Physics by D.C. Tayal, Himalaya Publication, Delhi,1982.					
8.	Nuclear Physics by Roy and Nigam, Wiley-Eastern, 1 st Edition 1967, first reprint 1979.					

		The Maharaja Sayajirao University of Baroda Faculty/College of <<Faculty of Science>>, Department of <<Physics>>		ACADEMIC YEAR 2019-2020		
<<M.Sc.>> : <<M.Sc. Physics >>						
YEAR	I	CORE:			CREDIT	4
Semester	II	<< PHY2208C10>> : <<Condensed Matter Physics>>			HOURS	60
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I	<<Title>>				15 hrs.	
	<<CRYSTAL BINDING AND COHESIVE ENERGY: Crystals of Inert gases, Van der waals-London Interaction, Repulsive Interaction, Equilibrium lattice constant, Cohesive energy, ionic crystals, Madelung energy & Constant, covalent crystals, hydrogen-bonded crystals, and metallic crystals. Atomic & Ionic radii. (Refs: Kittel; Ashcroft-Mermin) DEFECTS: Point defects: general thermodynamic features, color centers and optical properties of ionic crystals; linear defects, planar defects, volume defects. (Refs: Kittel; Ashcroft-Mermin)>>					
UNIT-II	<<Title>>				15 hrs.	
	<<ENERGY BAND THEORY: Motion of an electron in a periodic potential and Bloch's theorem, Kronig-Penney model, concept of band gap, Brillouin zones, extended, reduced and repeated zone schemes, distinction between metal, insulator and semiconductor, concept of holes and effective mass, cyclotron resonance. (Refs: Kittel; Dekker; Ashcroft-Mermin; Quant. Mech. book by Merzbacher;). NANOSYSTEMS: Quantum hetero-structures, size-quantization in confined structures, density of states in quantum wells, quantum wires and quantum dots. (Refs: Harrison)>>					
UNIT-III	<<MAGNETIC PROPERTIES>>				15 hrs.	
	<<Classification of magnetic materials and their characteristics, origin of magnetism, Bohr magneton, diamagnetism and Larmor precession, classical and quantum theories of paramagnetism, ferromagnetism, Weiss theory, ferromagnetic domains and hysteresis, anti-ferromagnetism, two sublattice model, ferrimagnetism; paramagnetic relaxation. (Refs: Kittel, Dekker, Ashcroft) >>					
UNIT-IV	<<DIELECTRIC PROPERTIES>>				15 hrs.	
	<<Static dielectric constant, polarization, electronic and ionic polarizabilities, orientational polarization, dielectric constant, Lorentz internal field, dielectric constant of solids, Clausius-Mosotti relation, complex dielectric constant and dielectric losses, relaxation time, electronic polarization and optical absorption; ferroelectricity: dipole theory, polarization catastrophe; introduction to piezoelectricity: (Refs: Kittel, Dekker, Ashcroft)>>					
REFERENCES						
1.	Introduction to Solid State Physics by Charles Kittel (8 th Ed., Wiley Eastern, 2004).					
2.	Solid State Physics by N. W. Ashcroft and N. D. Mermin (2 nd Ed., Holt-Saunders, 2000).					
3.	Solid State Physics by A.J. Dekker (Pan MacMillan, London, UK; Indian Edition by MacMillan India, 2000).					
4.	Quant. Mech. book by Merzbacher.					
5.	Quantum Wells, Wires and Dots by P. Harrison (Wiley & Sons, 2005).					

		The Maharaja Sayajirao University of Baroda Faculty of Science, Department of Physics		ACADEMIC YEAR 2021-22		
<<M.Sc. Physics>>						
YEAR	I	CORE:			CREDIT	2
Semester	II	<<PHY2203C22>> :<< COMPUTATIONAL PHYSICS >>			HOURS	30
Theory/Lab		Year of Syllabus Revision:			Max marks	50
COURSE CONTENT / SYLLABUS						
UNIT-I	<<>>					15 hrs.
	<< Coffee cooling problem, computer program for Coffee cooling problem.Motion of falling objects, numerical solution and computer programming in one and two dimensional trajectories.Random Number generation, Laplace equation in 2D. Kepler’s problems, equation of motion of planets, equations for circular and elliptical orbits. (Its numerical solution and programming.)>>					
UNIT-II	<<>>					15 hrs.
	<<Simple harmonic oscillators, simple/driven pendulum, damped oscillatory motion, chaotic motion. Oscillations in <u>LCR series/parallel</u> electric circuit: <u>Numerical simulations in Python.</u> Boundary value and eigen value problems: stationary solution of one dimensional Schrodinger equation using Numerov method algorithm. (TISE solution for one body in 1D).Scattering of particle by central potential (Born approximation & <u>Partial Wave Analysis</u>), <u>Python programs for numerical algorithm & evaluations.</u> >>					
REFERENCES (Text Books)						
1.	FORTRAN-90 & 95 by V. Rajaraman, 2004 Prentice Hall Pvt. Ltd., New Delhi.					
2.	Computational physics by S.F. Koonin (Addition – Wesley , NY) 1986					
3.	An introduction to computer simulationmethod PART – I (Addition – Wesley , NY) , 1998 by Gould and J. Tebochaik.					
4.	An introduction to computation physics by Tao Pang.(Cambridge Univ-Press, 1997)					
5.	Fundamentals ofPython Programming by Richard L. Halterman, Southern Adventist University.					

.....

		The Maharaja Sayajirao University of Baroda Faculty/College of <<Faculty of Science >>, Department of <<Physics >> <<Address>>, <<Contact details>>, <<e-mail ID>>		ACADEMIC YEAR 2019-2020	
<<Name of the Programme: M.Sc.>> : <<M.Sc. Physics >> 					
YEAR	I	CORE: <<PHY2210C12>> : <<PHYSICS LABORATORY-II>>		CREDIT	8
Semester	II			HOURS	
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
		<< LIST OF EXPERIMENTS >>			hrs.
		<<(A) General laboratory: 1. Michelson's Interferometer – II ('t' of thin glass plate) 2. Ultrasonic Interferometer 3. Vibrational spectrum of AIO molecule 4. E/m by Thomson method (CRT) 5. P-N Junction diode 6. Laser (λ and e) 7. Logic gates – II (combinational circuits) 8. Operational Amplifier (OP-AMP) 9. Fourier analysis 10. Dead time of GM counter 11. Hall effect (B) Computer Laboratory: FORTRAN programming on various numerical method applied to physical problems. >>			

.....XXXXXXX.....