

CBCS 2019

M.Sc. Semester-I (Effective from 2021-22 to ...)

Sr. No	Course code	Title of courses	Credit
1	PHY2101C01	MATHEMATICAL PHYSICS- I	3
2	PHY2102C02	CLASSICAL MECHANICS	4
3	PHY2104C03	ATOMIC & MOLECULAR SPECTROSCOPY	4
4	PHY2103C20	NUMERICAL ANALYSIS	2
5	PHY2108C05	ELECTRONICS	4
6	PHY2106C21	PHYSICS LABORATORY-I	8
Total			25

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		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:		CREDIT	3
Semester	I	<<PHY2101C01>> : <<MATHEMATICAL PHYSICS-I>>		HOURS	45
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I		<<TENSORS AND GROUP THEORY>>			15 hrs.
		<<Tensor analysis : introduction, definitions, contraction, direct product, summation convention, quotient rule, pseudotensors, Levi-Civita symbol, Irreducible tensors, Metric tensor. Group Theory:Definition of the group axioms, multiplication table, classes, subgroups, G sets, Homomorphism, Representation general and irreducible, Schur's lemma, characters, character table.>>			
UNIT-II		<<THEORY OF TRANSFORM AND CONTINUOUS GROUPS >>			15 hrs.
		<<Expression of the Piecewise continuous periodic function in finite interval, properties, simple problems, applications, Fourier transform, Convolution, Parseval's theorem, Momentum representation, Dirac delta function, convolution product, solving differential equation with given boundary conditions with transform. Continuous groups: Rotation group SO(3), Lie groups and Lie algebra, special unitary (SU) groups, SU(2) group.>>			
UNIT-III		<< SECOND ORDER DIFFERENTIAL EQUATION WITH VARIABLE CO-EFFICIENTS AND SPECIAL FUNCTIONS I >>			15 hrs.
		<< Regular point; Simple pole, Series solution-indicial equation, Recurrence relation, Convergence of the series, Existence and evaluation of the second order solution, Hermite polynomials and their properties. Legendre polynomials and Associated Legendre polynomials, Recurrence relations, Orthogonality and Generating functions.>>			
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.	Mathematical methods for physics and engineering K. F. Riley, M. P. Hobson and S. J. Bence, Cambridge university press 1998 (Low-price edition)				
3.	Advanced Engineering Mathematics Kreyzing 8 th edition, 2006, John Wiley & Sons (Asia Pvt.), Singapore .				
4.	Mathematical physics P. K. Chattopadhyay: 1990, New age international publisher New Delhi.				
5.	Elements of Group theory for physics A. W. Joshi, 4 th edition reprint 2002 New age international publishers, New Delhi.				
REFERENCES					
1.	Mathematics of Classical and Quantum Physics vol. I and II by Robert W. Fuller, Frederick W. 1992 Courier Dover Publications, NY, USA				
2.	Mathematical methods for physical sciences by M. L. Boas, 3 rd edition 2006, John Wiley and Sons, New York (2 nd Ed. 1983)				
3.	Advanced mathematical methods for scientists and engineers Carl M. Bender and Steven A. Orszag, Springer, 1999				

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<<Name of the Programme: M.Sc.>> : <<M.Sc. Physics >>							
YEAR	I	CORE:				CREDIT	4
Semester	I	<<PHY2102C02>> : <<CLASSICAL MECHANICS >>				HOURS	60
OBJECTIVES:							
COURSE CONTENT / SYLLABUS							
UNIT-I	<<Mechanics of a particles and two body central force problem >>					15 hrs.	
	<<(Review: mechanics of a system of particles, system subjected to different constraints and various examples, generalized coordinates) D' Alembert's principle, Lagrange's equations, problems, deduction of Lagrange's equation from D' Alembert's principle, applications of Lagrange's equation, generalized momenta and energy, (Review: Cyclic or Ignorable coordinates). Calculus of variations: The Euler-Lagrange equation, First integral geodesics, Thebrachistochrone, Minimum surface of revolution, Several dependent variable.>>						
UNIT-II	<<HAMILTONIAN FORMULATION >>					15 hrs.	
	<<Hamilton's principle, Lagrange's equation from Hamilton's principle, Rayleigh's dissipation function, integral of motion, symmetry properties of space and time and conservation theorems.Reduction to one body problem, center of mass and relative motion, equation of motion and first integrals, equivalent one dimensional problem, Principle of least action, Hamilton's principle, derivation of Hamilton's equation of motion for holonomic system from Hamilton's principle and characteristic functions. >>						
UNIT-III	<< RIGID BODY >>					15 hrs.	
	<<.(Review: number of degree of freedom, Euler's angles and Euler's theorem), infinitesimal rotation, rate of change of vector, (Review: Coriolis force, angular momentum and kinetic energy of a rigid body), the inertia tensor and moment of inertia, principle axes transformation, Euler's equation of motion. Precession of a charged body in a magnetic field. Small oscillations, normal modes and coordinates, transition from a discrete to a continuous system, the Lagrangian formulation for continuous system, constant of motion and symmetry properties >>						
UNIT-IV	<<CANONICAL TRANSFORMATION AND HAMILTONIAN - JACOBI THOERY>>					15 hrs.	
	<<Canonical transformation and its examples, generating functions, Poisson brackets, equation of motion, invariance of Poisson brackets under canonical transformations, angular momentum, Poisson brackets relations, infinitesimal canonical transformation, problems, Hamilton's principle and characteristic function, separation of variables in H – J method, action angle variables interpretation (for/with one degree of freedom).>>						
REFERENCES (Text Books)							
1.	Introduction to classical mechanics by Golstein Poole &Safko (Pearson Education , Asia) 1 st editin, 2002 (Low Price Editin)						
2.	Classical Mechanics – N. C. Rana and P. S. Jog 1991, Tata McGraw-Hill Pub. Co. Ltd., New Delhi.						
3.	Introduction to Classical Mechanics R. G. Takwale and P. S. Puranik, 1979, Tata McGraw-Hill Pub. Co. Ltd., New Delhi.						

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>							
YEAR	I	CORE:				CREDIT	4
Semester	I	<< PHY2104C03 >> : << ATOMIC & MOLECULAR SPECTROSCOPY >>				HOURS	60
OBJECTIVES:							
COURSE CONTENT / SYLLABUS							
UNIT-I	<< >>					15 hrs.	
	<<Intensity rules, central field approximation, interaction energy in L-S coupling and j-j coupling (two electron system). Broadening of spectral lines, natural broadening, Doppler broadening and external effects, nuclear spin and hyperfine structure. Lasers :- Active medium, light amplification in an inverted active medium, methods of creating population inversion, principal pumping schemes. Quality factor, different kinds of losses in a cavity, laser induced fluorescence.>>						
UNIT-II	<< Astronomy and astrophysics >>					15 hrs.	
	<<Basics of observational astronomy and astrophysics, Observed properties of stars (basics) Stellar evolution : Stars in formation, Virial-theorem, stellar energy generation, stellar energy cycle, evolution of stars, and end states of stars – white dwarfs, Neutron stars and black holes (qualitative), Mass radius relations, binary star (introductory).>>						
UNIT-III	<< >>					15 hrs.	
	<< Microwave spectroscopy :- Rigid rotator, non-rigid rotator, intensity of rotational lines, band head formation, intensity distribution in rotational structure, isotopic shift in rotational lines, techniques and instrumentation. IR Spectroscopy :- Vibrating diatomic molecule as a harmonic oscillator and an-harmonic oscillator, vibrational frequency and force constant for an-harmonic oscillator, vibrating rotator, isotopic shifts in vibrational bands, techniques and instrumentation>>						
UNIT-IV	<< Raman Spectroscopy >>					15 hrs.	
	<< Raman spectra, Classical and quantum theory of Raman effect, Raman spectra and molecular spectra, infra-red spectra versus Raman spectra, principles of laser Raman spectroscopy, Frank-Condon principle, Heitler and London theory of H ₂ molecule, NMR, EPR.>>						
REFERENCES (Text Books)							
1.	Elements of Spectroscopy by Gupta, Kumar, Sharma, Pragati Prakashan, 2007.						
2.	Laser Spectroscopy by W. Demtroder, 2 nd Edition, Springer, 1998.						
3.	Astrophysics : stars and Galaxies by K. D. Abhyankar Universities press (India) Limited 2001.						
4.	Astrophysics – A Modern Perspective by K.S. Krishnaswamy. New. Ag International Publishers, 1996						
5.	Molecules Spectroscopy - C.N. Banwell, McGraw Hill 1985						

6.	Molecules Spectra and Molecular Structure, Vol.- I, II and III, by G.Herzberg, Van Nostrand Co., N.Y.1950
REFERENCES	
1.	Atomic Spectra by H.E. White.
2.	Laser Physics and Applications by Tarasov
3.	Contemporary Astronomy by J. Pasacchoff CBS college publishing, 1981
4.	Astronomy by Robert H. Baker.
5.	Atomic and Molecular Spectra by Rajkumar, Kedas North Ram North, 2008

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		The Maharaja Sayajirao University of Baroda Faculty of Science, Department ofPhysics			ACADEMIC YEAR 2021-2022	
<<M.Sc. Physics >>						
YEAR	I	CORE: <<PHY2103C20>> : <<NUMERICAL ANALYSIS >>			CREDIT	2
Semester	I				HOURS	30
Theory/Lab		Year of Syllabus Revision:			Max marks	50
COURSE CONTENT / SYLLABUS						
UNIT-I		<<NUMERICAL METHODS >>				15 hrs.
		<<Finite difference method, eigen values of matrix, matrix diagonalisation, Monte Carlo method. Random number generator, <u>Application of random numbers:evaluation of π and radioactive decay</u> , Numerical differentiation, Numerical integration: <u>Trapezoidal, Simpson 1/3 & 3/8 methods</u> , two-dimensional integration.				
UNIT-II		<<COMPUTER PROGRAMMING >>				15 hrs.
		COMPUTER PROGRAMMING Reviews of basic concepts of FORTRAN-90 and 95, procedure with array, Function and sub-program, subroutine, data statement, user defined operations, array values, Do while, implicit statement, program of complex numbers and variables, processing of files. <u><<Basic concepts of Python: Corresponding Python programs for numerical evaluation : Relevant to computational physics laboratory need>></u> Examples:1) Lagrange interpolation. 2) Millikan experiment with direct linear fit. 3) Derivatives with three point formulas. 4) To find the Madlung energy of the alkali halide types of ionic crystals. 5) To find the bond length of crystal like NaCl.>>				
REFERENCES (Text Books)						
1.	Fundamentals ofPython Programming by Richard L. Halterman, Southern Adventist University.					
2.	Computational physics by S.F. Koonin (Addition – Wesley , NY) 1986					
3.	An introduction to computer simulation method PART – I (Addition – Wesley, NY) 1998 by Gould and J. Tebochaik.					
4.	An introduction to computation physics by Tao Pang.(Cambridge Univ.-Press, 1997)					

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 THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA सत्यं शिवं सुन्दरम्		<< Physics Department, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara - 390 002>>, << Phone : +91-265-2795339>>, << >>		ACADEMIC YEAR 2019-2020		
<<M.Sc.>> : <<M. Sc. Physics>>						
YEAR	I	CORE: <<PHY2108C05>> : <<ELECTRONICS>>			CREDIT	4
Semester	I				HOURS	60
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I		<<SEMICONDUCTOR DEVICE PHYSICS & DIGITAL CIRCUITES>>				15 hrs.
		<<SEMICONDUCTOR DEVICE PHYSICS: Energy distribution of electrons in a semi conductors, The Fermi-Dirac function, The density of states, Carrier concentration in an intrinsic semiconductor, Fermi level in a semiconductor having impurities, Band structure of open circuit p-n junction, Basic semiconductor equations, The p-n diode volt-ampere equation. DIGITAL CIRCUITES: Concept of Binary and Hexadecimal number systems, BCD codes, Introduction to RTL, DTL, TTL and CMOS logic families, Boolean algebra, De Morgan's theorem, Karnaugh mapping, Half adder, Full adder and subtractor. Flip Flop circuits, RS, J-K, Master slave, D type and T type FF circuits.>>				
UNIT-II		<<COUNTERS & SHIFT RESISTORS>>				15 hrs.
		<< COUNTERS: Asynchronous and Synchronous (up and down) Mod-N-counters, ring counters and counters as frequency dividers. SHIFT RESISTORS: Basic shift resistors, Left right shift resistor, serial in and parallel out, Parallel in and serial-out, Parallel-in and Parallel-out shift resistors, Multiplexers and De-multiplexers, Encoders, Decoders, and Buffers.>>				
UNIT-III		<<APPLICATION OF OPERATIONAL AMPLIFIER & Amplifiers>>				15 hrs.
		<<APPLICATION OF OPERATIONAL AMPLIFIER : Review of fundamentals (Inverting and non-inverting amplifier), Analog Amplifier:- adder, Sub, Multiplication, Voltage to current, current to voltage converter, Integrator, differentiator, comparators, and Schmitt, trigger. Amplifiers: Two stage RC coupling (Potential), Inductive Coupling, Transformer Coupling, Class A amplifier, efficiency and push pull operation, AC load line and Q point, power output, Class B push pull amplifier, Cascaded stages, Tuned class C amplifier. >>				

UNIT-IV	<< OSCILLATORS >>	15 hrs.
	<< OSCILLATORS Theory of oscillators, Hartley / Collpitts oscillators, phase shift oscillators, crystal oscillators, Wein Bridge oscillators. UJT Characteristics, relaxation oscillator and as a switch . FET, MOSFET (D-Type and E-Type) characteristics, FET as an amplifier. >>	
REFERENCES		
1.	Integrated Electronics by Milman and Halkias, McGraw-Hill.	
2.	Digital Technology By Virendra Kumar , New Age International	
3.	Fundamental of Electronics Devices by Milman and Halkias, McGraw-Hill.	
4.	Digital Principles and Application by Malvino and Leach (TMH).	
5.	Hand Book of Electronics – Gupta and Kumar, Pragati Prakashan.	
6.	Digital Technology by Tokheim - TMH	

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		The Maharaja Sayajirao University of Baroda		ACADEMIC YEAR 2021-2022	
Faculty of Science, Department of Physics					
<< M.Sc. Physics >>					
YEAR	I	CORE: <<PHY2106C21>> :<<LABORATORY >>		CREDIT	8
Semester	I			HOURS	16
COURSE CONTENT / SYLLABUS					
UNIT-I	<< LIST OF EXPERIMENTS >>				16 hrs.
	<<(A) General laboratory: 1. Child Langmur`s law 2. Michelson interferometer-I with Laser source 3. R-C coupled amplifier 4. Dissociation energy of I ₂ –molecule 5. Talbot bands 6. Rayleigh interferometer 7. Feedback amplifier 8. e/m by Thomson method (CRT) 9. Gas filled photocell 10. Fourier Analysis 11. LogicGates-I (Basic circuits) 12. Multivibrator (B) Computer Laboratory: Fortran 90 / <u>Python3</u> programming on various numerical methods applied to physical problems. >>				

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