

CBCS-2019**Distribution of Credits for M. Sc. Physics Semester - III**

Sr. No	Course code	Title of core courses	Credit
1	PHY2301C13	ADVANCE QUANTUM MECHANICS	4
2	PHY2302C14	CLASSICAL ELECTRODYNAMICS & PLASMA PHYSICS-I	3
3	PHY2304E01	EXPERIMENTAL TECHNIQUES - I (Elective paper)	3
4	PHY2305E01	ASTROPHYSICS AND COSMOLOGY (Elective paper)	3
5	PHY2306E01	Advanced Theoretical Physics (Elective paper)	3
6	PHY2307S01	ELECTRONICS & COMMUNICATIONS-I (Specialization Paper)	3
7	PHY2308S02	ELECTRONICS & COMMUNICATIONS-II (Specialization Paper)	4
8	PHY2309S01	NUCLEAR PHYSICS - I (Specialization Paper)	3
9	PHY2310S02	NUCLEAR PHYSICS - II (Specialization Paper)	4
10	PHY2311S01	CONDENSED MATTER PHYSICS - I (Specialization Paper)	3
11	PHY2312S02	CONDENSED MATTER PHYSICS - II (Specialization Paper)	4
12	PHY2313S01	ATOMIC & LASER SPECTROSCOPY-I (Specialization Paper)	3
13	PHY2314S02	MOLECULAR SPECTROSCOPY-I (Specialization Paper)	4
14	PHY2303C15	PHYSICS LABORATORY-III	7
Total			24

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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	II	CORE: << PHY2301C13 >> : << ADVANCE QUANTUM MECHANICS >>		CREDIT	4
Semester	III			HOURS	60
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	<< >>				15 hrs.
	<<Time dependent perturbation theory, Interaction picture, Transition amplitude, First-order perturbation, Harmonic perturbation, Transition probability, Second -order perturbation, Adiabatic and sudden approximation, Interaction of an atom with electromagnetic radiation (semi classical treatment), Absorption and emission of radiation. The dipole approximation, selection rules.>>				
UNIT-II	<< >>				15 hrs.
	<< Angular Momentum : Matrix Representation of Angular Momentum, Pauli's spin matrices and their algebra, Addition of angular moment, Simple examples. Coupling of two angular momenta and C.G. Coefficients for $J_1=1/2$, $J_2=1/2$, and $J_1=1, J_2=1/2$. Many Electron Atom : Central field approximation, Hartree method of self Consistent fields, Ground states of He atom, Hartree-Fock methods : Ortho and Para states of He.>>				
UNIT-III	<< >>				15 hrs.
	<<Relativistic Quantum Mechanics: Klein-Gordon equations, charge & current densities, physical interpretations and short comings of K-G equation, Dirac equation and its derivation, Dirac matrices and their properties, constant of motion for Dirac equation (spin of Dirac particle), electron in electromagnetic field, Spin-orbital interaction energy , free particle solution of Dirac equation, negative energy states and the concept of hole, Dirac equation for spherically symmetric potential, deduction of K-operator and commutation relations for H, K and J; Eigenvalues of K, reduction of Dirac equation to a radial equation, solution of radial equation for hydrogen-like atom, fine structure corrections to energy.>>				
UNIT-IV	<< >>				15 hrs.
	<< Quantization of Fields: Classical radiation fields, Fourier decomposition and radiation oscillators, creation, annihilation and number operators, quantization of radiation oscillators, quantized radiation fields, photon states, quantization of non relativistic Schrödinger wave equations for Bosons as well as for Fermions, Matrix representation of creation, annihilation and number operators and their states for Fermions. >>				
REFERENCES					
1.	Advance Quantum Mechanics- by J.J. Sakurai, Addison-Wesley				
2.	Quantum Mechanics - by B. K. Agrawal & Hari Prakash (PHI EEE, 2004)				
3.	A Text book of Quantum Mechanics: P. M. Mathews & K. Venkatesh. Tata McGraw-Hill Publ. Company Ltd. New Delhi (10 th reprint) 1986				
4.	Quantum Mechanics LI shift (Mc Graw Hill)				
5.	Quantum Mechanics Vol.-II: A. Messiah, John Wiley & Sons, New York 1868.				
6.	Quantum Physics – by S. Gasiorowicz (III Ed.) ,Wiley				

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<<Name of the Programme: M.Sc.>> : <<M.Sc. Physics >>							
YEAR	II	CORE: <<PHY2302C14>> : <<CLASSICAL ELECTRODYNAMICS & PLASMA PHYSICS-I>>				CREDIT	3
Semester	III					HOURS	45
OBJECTIVES:							
COURSE CONTENT / SYLLABUS							
UNIT-I	<< >>					15 hrs.	
	<< Different system of units in electromagnetic theory, Maxwell’s equation in Gaussian and MKS system of units, Conservation laws, Energy density, Poynting vector, Maxwell stress tensor, Solution of Maxwell’s equations in infinite dielectric and conductin medium, plane wave and spherical wave solution, polarisations and their properties (Stoke parameters).Superposition of waves, kinematics of dispersion and classical theory of dispersion, Normal and anomalous dispersion.>>						
UNIT-II	<< >>					15 hrs.	
	<< Dispersion in conducting medium, plasma frequency and reflection in ionosphere. Dynamical boundary conditions at the interface, Reflection and refraction at the interface, Fresnel’s amplitude relations for parallel and perpendicular polarizations, Reflection and Transmission coefficients for interfaces between dielectric-dielectric and dielectric-metal, polarization by reflection, total internal reflection, skin depth and metallic plasma.>>						
UNIT-III	<<>>					15 hrs.	
	<< Reflection and transmission through dielectric slab, multiple reflections and Transmissions, Wave Guide and Resonant cavities, propagation of TM, TE and TEM modes in rectangular and cylindrical wave guides and cavities, Energy flow and power losses in wave guides and cavities. Perturbation of boundary conditions.>>						
REFERENCES							
1.	Classical Electrodynamics : Jackson J.D. 2 nd Edition John Wiley & Sons New York, 1963.						
2.	Classical Electricity and Magnetism : Panofsky W. K. H. and M. Phillips, 2 nd Edition, ReadingMass. : Addison-Wesley (AW) 1962.						
3.	Feynman Lectures, Vol.-II. AW, MIT reading 1965, Narosa Pub. 1995						
4.	Introduction to Electrodynamics: D. J. Griffiths. 3 rd Ed. PHI, New Delhi 2001						
5.	Classical Electrodynamics: S. P. Puri, Tata McGraw-Hill Publ. Company Ltd.New Delhi 1990						

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<< M.Sc. >> : << M.Sc. Physics >>							
YEAR	II	CORE: << PHY2304E01 >>: << Elective Paper: EXPERIMENTAL TECHNIQUES-I >>				CREDIT	3
Semester	III					HOURS	45
OBJECTIVES:							
COURSE CONTENT / SYLLABUS							
UNIT-I	<<Title>>					15 hrs.	
	<<Vacuum Pumps : Rotary pump, Diffusion pump, Sputter – Ion pump, Sorption pump, Turbomolecular pump. Gauges: Bourdon Gauge, Mcleod gauge, Pirani gauge, Thermocouple gauge, Hot and cold cathode ionization gauge. Vaccum Materials, Thickness measurement technique.>>						
UNIT-II	<<Title>>					15 hrs.	
	<<Chemical wet Processing, Solgel method, Ball-milling method, Melt and Vapour Growth methods (Zone, Bridgman, Czochralsky) Thermal Evaporation, Chemical vapour deposition (CVD); Sputtering - RF, Pulsed Laser Deposition (PLD)Beam; Molecular Beam Epitaxial Growth (MBE)>>						
UNIT-III	<<Title>>					15 hrs.	
	<<Review of powder X-ray, electron and Neutron diffraction Electron microscopy- Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM); Field Emission and Field Ion Microscopies (FEM & FIM), Application as Atom Probe, Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM).>>						
REFERENCES							
1.	Modern Vacuum Practice - by Nigal Harris, Tata McGraw Hill Publ., New York.						
2.	Thin Film Technology and Applications - by K. L. Chopra & L. K. Malhotra, Tata McGraw Hill Publ., New Delhi.						
3.	Thin film Techniques by Joy George, Marshall Dekkar Inc. 1992						
4	A.V.S. Monograph on Vacuum technology by Harland G. Tompkins, A. V. Society Publ. 2 nd ed. (1991).						
5	Ultra high vacuum techniques Edited by D.K. Awasthi, A.Tripathi, A. C. Gupta Allied publishers Pvt. Ltd. (2002)						
6	Modern Techniques of Surface Science - by D.P. Woodruff & T.A. Delchar, Cambridge University Press, Cambridge.						
7	Solid State Physics - by R.L. Singhal, 7 th Ed. Kedarnath Ramnath & Co.						
8	Elements of X-ray diffraction,2 nd edition by B.D.Cullity,Addison Wesley Publ. Comp.Inc.(1978)						

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<<M.Sc.>> : << M.Sc. Physics>>							
YEAR	I	Elective:				CREDIT	3
Semester	I	<<PHY2305E01>> : << Elective Paper: Astrophysics and Cosmology>>				HOURS	45
OBJECTIVES:							
COURSE CONTENT / SYLLABUS							
UNIT-I		<<General Introduction and Stellar properties >> <<Basics of electromagnetic radiation in astrophysics : Radiative flux, Radiative transfer : emission, absorption, Radiative transfer equation(brief), Eddington approximation, Brief introduction to astrophysical plasma and astrophysical fluid. Observational aspects: brightness measurement, interstellar absorption, reddening, colour magnitude diagram (inclusive two colours), Brief introduction: Sun as a star and planetary system (description of planet, their satellites origin of planetary rings atmosphere of planets(thermal structure)), stellar distances and absolute luminosities. Basic properties of stars : Spectral classification, formation of spectral lines, structure of spectral lines, photo diffusion in side Sun.>>					15 hrs.
UNIT-II		<<Stellar dynamics, Galaxies and Interstellar medium>> <<Stellar structure, stellar hydrostatic equilibrium, Simplified stellar models, equation of radiative transfer, radiation in solar atmosphere, Nuclear energy generation rates, energy generation cycle, Nature of galaxies(properties of normal galaxies), Hubble sequence, spirals and irregular galaxies, Spiral structure, Elliptical galaxies, Galactic evolution : Formation of galaxies(brief), Interstellar medium and its physical properties, Interstellar gas and electron density, , Interstellar dust grains and grains properties, grain evolution, interstellar gas dynamics, Gaseous Nebulae, H II regions. For Unit I, II Astrophysics : K. D. Abhyankar, Universities Press, Hyderabad. 2005 Astrophysics –I and II R. Bower and T Deeming, Jones and Barlett, 1984. Astrophysics for physicists : Arnab Rai Choudhari, Cambridge University press, 2010>>					15 hrs.
UNIT-III		<<Cosmology and its observational support>> <<Structure of the universe, Extragalactic distance scale, External galaxies, Clusters of galaxies, Theoretical foundation of cosmology : The metric of the Universe, Friedmann equation and scale factor of the Universe, matter and radiation content of the Universe, Universe at early epoch, the age of the Universe, brief thermal history of the Universe, formation of elements, : Cosmic Microwave background radiation (CMBR), some problems with cosmological models, different probes : COBE, WMAP, galaxy and red-shift surveys, High-red shift Supernovae Surveys, brief about dark matter and dark energy. Ref : Astrophysics for physicists : Arnab Rai Choudhari, Cambridge University press, 2010 Classical Theory of Fields, Vol. II, L. D. Landau and E. M. Lifshitz, Oxford : Pergamon Press. Introduction to Cosmology, 3rd Edition, J. V. Narlikar, Cambridge University Press.>>					15 hrs.
REFERENCES							
1.		Astrophysics : K. D. Abhyankar, Universities Press, Hyderabad. 2005					
2.		Astrophysics –I and II R. Bower and T Deeming, Jones and Barlett, 1984.					

3.	Astrophysics for physicists : Arnab Rai Choudhari, Cambridge University press, 2010
4.	Astrophysics for physicists : Arnab Rai Choudhari, Cambridge University press, 2010
5.	Classical Theory of Fields, Vol. II, L. D. Landau and E. M. Lifshitz, Oxford : Pergamon Press.
6.	Introduction to Cosmology, 3rd Edition, J. V. Narlikar, Cambridge University Press.
7.	The Physical Universe: An Introduction to Astronomy, F. Shu, Mill Valley : University Science Books.
8.	Modern Astrophysics, B. W. Carroll and D. A. Ostlie, Addison-Wesley Publishing Co.
9.	Theoretical Astrophysics, Vol. I: Astrophysical Processes, T. Padmanabhan, Cambridge Univ. Press (2000).
10.	Theoretical Astrophysics, Vol. II: Stars and Stellar systems, T. Padmanabhan, Cambridge Univ. Press (2001).
11.	Theoretical Astrophysics, Vol. III: Galaxies and Cosmology, T. Padmanabhan, Cambridge University Press (2002).

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		The Maharaja Sayajirao University of Baroda Faculty/College of <<Faculty of Science>>, Department of <<Physics Department>> << 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	II	CORE: <<PHY2306E01>> : <<Elective Paper: Advanced Theoretical Physics>>			CREDIT	3
Semester	III				HOURS	45
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I	<<General Theory of Relativity And Its Applications (A Few)>>				15 hrs.	
	<<Introduction to totally symmetric and anti-symmetric tensors in higher dimension, principle of general covariance, parallel transport, Covariant derivative, Riemann geometry, some useful identity and locally inertial coordinates, physics in curved space-times, Riemann tensor, its properties and other identities, geodesics, geodesic deviation, symmetries of various tensors in curved space-time, principle of equivalence, energy momentum tensors, variation of metric tensor, energy tensor of matter, action principle, its conservation properties, Einstein's field equations (heuristic and action approach), Newtonian approximation, A few solutions of Einstein field equation : Schwarzschild(exterior, interior), motion of a test particle and it comparison with Newtonian approximation, cosmological solution (Friedman, de-Sitter etc.) Formal introduction to gravitational radiation: theory and experiment>>					
UNIT-II	<<Density Functional Theory>>				15 hrs.	
	<< introduction, quantum theory and the origins of electronic structure, Born-Oppenheimer Approximation, Hartee Method, Hartee-fock (H-F) method, application of Hartee and Hartee-fock (H-F) methods to homogeneous electron gas, What is functional, functional derivatives, Hohenberg-Kohn theorems, Thomas-Fermi, Kohn-Sham equations, Exchange, Correction, Local approximations, Local density approximation, Kohn-Sham equations.>>					
UNIT-III	<<Angular Momentum, many body systems of identical particles>>				15 hrs.	
	<<Density Matrix, Density Matrix and statistical ensemble using Density Matrix- Spin Polarization and scattering, information and density matrix, Tensor operators and Wigner Eckart Theorem, Applications of Wigner-Eckart Theorem, Angular momentum of system of identical particles.>>					
Textbooks						
1.	Introduction to Relativity by J. V. Narlikar, Cambridge University Press (Indian Edition), 2010					
2.	Introduction to Cosmology by J. V. Narlikar Cambridge University Press (Indian 3 rd Edition), 2002.					
REFERENCES						
1.	Principles of Physical Cosmology by P. J. E. Peebles, Princeton Series in physics, (1993)					
2.	Cosmology by Steven Weinberg, Oxford university press (2008).					
3.	Principles of Cosmology and Gravitation, Michael V Berry, Institute of physics					

	publishing, (1989), Reprint (2001).
4.	Cosmology by Peter Coles, Oxford university press (2001).
5.	Fundamentals of Interferometric Gravitational Wave Detectors by Peter R Saulson World Scientific Publishing (1994).
6.	Advanced Gravitational Wave Detectors, Editors :David G. Blair, Eric J. Howell, Li Ju and Chunnong Zhao Cambridge University Press (2012).
7.	Density Foundation Theory: An approach to the Quantum Many-Body Problem by R. M. Dreizler and E.K.U. Gross.
8.	Electronic structure: Basic Theory and Practical Methods by Richard M. Martin.
9.	Understanding Molecular Simulation From Algorithm to applications by Daan Frenkel and Berend Smit.
10.	Quantum Mechanics by E Merzbacher (3 rd Edition)

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<< M.Sc. >> : << M. Sc. Physics >>							
YEAR	II	CORE: << PHY2307S01 >> : << ELECTRONICS&COMMUNICATIONS-I(Specialization Paper) >>				CREDIT	3
Semester	III					HOURS	45
OBJECTIVES:							
COURSE CONTENT / SYLLABUS							
UNIT-I		<< >>				15 hrs.	
		<<Modulation and Demodulation: Amplitude modulation, modulation index, single sideband principles, Sideband power distribution of an AM wave, AM modulators and demodulators, square law modulation, DSSB generation and reception. Data Communication system: Data representation, modes of data transmission, Signal encoding, Tansmission media, Telephone network, sampling theory, quantizing of analog signals, quantization error, Frequency and time division multiplexing, Digital modulation methods, ASK, FSK, and PSK, modems, Error detection and correction: Parity checking, Checksum error detection.>>					
UNIT-II		<<>>				15 hrs.	
		<<Digital Communication: Principle of digital communication system, layers of digital communication system, Bit transmission and signaling rate, error probability, digital filtering, pulse code modulation, bandwidth and noise in PCM, Quantization and Quantization noise, PCM encoding and system. Seven segment Displays. Optical Sources: LEDs and Lasers, tunnel diode, Gun diode, PIN diode Photo detectors-Pin detectors, detector responsivity, noise, optical receivers. Opto couplers. Fiber Optic Communication: Principle of light transmission in a fiber, effect of index profile on propagation, modes of propagation, number of modes in a fiber, losses in fibers, dispersion in fiber, source and detectors for fiber optic, connectors and splices, fiber optic communication systems..>>					

UNIT-III	<<>>	15 hrs.
	<<Transmission Lines: Wavelength and velocity of propagation, waveform distortion, distortion less lines, reflection of lines, characteristics impedance, open and short transmission lines, reflection factor and loss, standing wave and its ratio, Input impedance of distortionless lines, Power and impedance measurements. Wave Guides: Plane parallel wave guide, modes of transmission, characteristics of modes of transmission, propagation constant, phase and group velocity, skin effect, TM modes, specific wave impedance, cut off and characteristics power transmitted, Rectangular wave Guide >>	

REFERENCES

1.	Data Communications and Computer Networks by P.C. Gupta, PHI Publication 2006
2.	Electronics communication systems, George Kennedy & Davis, Mc.Graw., Hill.
3.	Electronic Communications, Roddey & Coolen, PHI
4.	Communication systems, R. P. Singh and S. D. Sapre, TMH
5.	Communication systems, Simon Haykin, Mc Graw Hill
6.	Modern electronic Communication by Ajay Sharma and RK Sinha , Dhanpat Rai Pub
7.	J. Keiser, Fibre Optic communication, by J. Keiser, McGraw Hill, 2 nd Edition 1992
8.	Optical Fibers for Transmission, by J.E.Midwinter, John Wiley 1979
9.	Understanding Optical Communications, by H. Dutton, Printice Hall
10.	Network lines and fields, J. D. Ryder, Asia Pub. House

		The Maharaja Sayajirao University of Baroda Faculty/College of << Faculty of Science >>, Department of << Physics Department >> << 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	II	CORE:				CREDIT	4	
Semester	III	<< PHY2308S02 >> : << ELECTRONICS & COMMUNICATIONS-II (Specialization Paper) >>				HOURS	60	
OBJECTIVES:								
COURSE CONTENT / SYLLABUS								
UNIT-I		<< >> << Applications of Op-Amp: Design and working of Op-amps as differential, Instrumentation amplifier, Signal Generator: Monoshot / Pulse Generator , , free running, triangle and sawtooth wave generators. Voltage controlled Oscillator , Sample and Hold Circuit , Precision Rectifiers. Filters: Active RC filter design: use of finite and infinite gain amplifiers. Two integrator loop and high order filter design. Design of Active Filter Circuits: Butter worth Filter, Low pass, high pass, band and notch filters, Bode and dB plots>>					15 hrs.	
UNIT-II		<<>> <<VLSI Technology: An overview of VLSI, Ideal switches and Boolean operations, MOSFET as switches CMOS Logic gates, Complex logic gates in CMOS, Integrated circuit layers MOSFETS, CMOS layers, Fabricating of CMOS Integrated circuits by Lithography, Layout of Basic structures of MOSFETs, nFET current-voltage equations, DC characteristics of CMOS Inverter, Power Dissipation in CMOS, High speed CMOS network gate delays, VLSI system multiplexors, VLSI clocking, clocked flip flops, CMOS clocking.>>					15 hrs.	
UNIT-III		<<>> <<Microprocessor Architecture and Programming: Encoders, Decoders, Buffers, 8085 Intel microprocessor architecture, DRAM and SRAM Memory, Memory organization, types of memory, Memory mapping, 8085 control lines, ALU, Flags, registers, data and address bus. I/O mapped I/O and memory mapped I/O, status					15 hrs.	

	signals, 8085 Assembly language and its instruction set, basic instructions; addressing modes, data transfer, arithmetic operations, logic operations, branch operations, 16 bit arithmetic operations, memory operation, rotate, compare operations and assembly language programs.>>	
UNIT-IV	<<>>	15 hrs.
	<<Memory interfacing, I/O Interfacing, counters and delays Op-code Fetch operation, execution of instruction, instruction cycle, machine cycle, memory read, memory write, I/O read, I/O write, Timing diagram, stack and subroutine, 8085 interrupts, Interrupts and Interrupt service procedures, and assembly language programs based on these.>>	
REFERENCES		
1.	Op-amp and Linear Integrated circuits: Ramakant Gayakwad, PHI	
2.	Operational Amplifier and Linear IC, RF Coughlin and F. F. Driscoll, PHI	
3.	S.K.Mitra, Active Inductorless Filters, IEEE Press 1971	
4.	Operational Amplifier and Linear IC, RF Coughlin and F. F. Driscoll, PHI	
5.	Solid State Pulse Circuits By David A. Bell , PHI	
6.	Introduction to VLSI circuits and Systems: J.P. Ugemura, Wiley 2001	
7.	Microprocessor and Programming, B. Ram, Dhanpatrai Pub.	
8.	Microprocessor Architecture, Programming and Application, R. S. Gaonkar, Penram International	
9.	Digital Principles and Application, A. P. Malvino and D. Leach, TMH	

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>					
YEAR	II	CORE: <<PHY2309S01>> : <<NUCLEAR PHYSICS-I (Specialization Paper) >>		CREDIT	3
Semester	III			HOURS	45
COURSE CONTENT / SYLLABUS					
UNIT-I	<< Nuclear radiation Detectors and Spectrometers >>				15 hrs.
	<<Scintillation detectors, Type of scintillators, Semiconductor detectors- depletion region, silicon diode detectors, Si(Li), Ge(Li), HPGe detectors, Gamma-ray spectrometer, analysis of gamma-ray-spectra, Response function, Alpha and beta spectrometers, Error Propagation, Nuclear reaction of interest in neutron detection, BF ₃ detectors >>				
UNIT-II	<<Nuclear Electronics>>				15 hrs.
	<<Nuclear Electronics for Pulse signal processing - Pre-amplifiers, amplifiers, pulse shaping, discriminators, single channel analyzer, analog-to-digital converters and multi-channel analyzer, time to amplitude converters (TAC), basic coincidence technique, Resolving time characteristics of a coincidence set up, Compton rejection by anti-coincidence, Charge particle identification , Applications of coincidence technique in nuclear experiments.>>				
UNIT-III	<<Particle Accelerators & Nuclear Reactions>>				15 hrs.
	<<Acceleration of charged particles, Van de Graaff accelerator, Tandem accelerators, Linear accelerators, Cyclotron, Synchrocyclotron and their applications. Compound nuclear reaction cross sections, Continuum theory, Statistical model, Ghoshal experiment, Pre-equilibrium reaction mechanism. >>				
REFERENCES					
1.	Techniques for Nuclear and Particle Physics Experiments by W. R. Leo.				
2.	Nuclear Radiation Detectors by S. S. Kapoor and V. S. Ramamurthy.				
3.	Experimental Nuclear Physics by R. M. Singru.				
4.	Radiation Detection and Measurement by G. F. Knoll				
5.	Introductory Nuclear Physics, Wiley India, by Kenneth S. Krane.				
6.	Atomic and Nuclear Physics Vol-II, S. N. Ghosal.				
7.	Nuclear Physics by R.D. Evans				

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>						
YEAR	II	CORE: << PHY2310S02 >> : << NUCLEAR PHYSICS-II (Specialization Paper) >>			CREDIT	4
Semester	III				HOURS	60
COURSE CONTENT / SYLLABUS						
UNIT-I	<<>>				15 hrs.	
	<< Mass formula and Nuclear Models I:Semi-empirical mass formula and its applications, Mass parabola. The extreme single-particle shell model, Spin-orbit interaction and magic numbers, Ground state spin and parity, Magnetic moment-Schmidt lines, Deformed nuclei and nuclear electric quadrupole moments. Single particle model, Total spin J for various configurations; Ground state spins of odd-odd nuclei (Nordheim's rule)>>					
UNIT-II	<<>>				15 hrs.	
	<<Two body problem and Nuclear Models II:Phenomenological nucleon-nucleon potential, Meson theory, Derivation of Yukawa interaction, Electromagnetic properties of deuteron and tensor forces. Scattering matrix, Probing charge distribution with electrons, Form factors of nuclei and nucleons. The Nilsson model, The collective model: Vibrational levels, Rotational levels of even-even nuclei>>					
UNIT-III	<<>>				15 hrs.	
	<< Nuclear Beta- Decay, Review of Fermi theory of β -decay. Electron capture, Two-component neutrino theory, Inverse β -decay and neutrino detection. Solar neutrinos; Parity violation and Wu's experiment, Helicity, Gamma decay, Spontaneous decay, Transition rates, selection rules. Nuclear isomerism, Coulomb excitation, Alpha decay.>>					
UNIT-IV	<<>>				15 hrs.	
	<<Nuclear Astrophysics- Cosmic abundances, Evolution of stars, Nucleo-synthesis of elements in stars, s- and r- processes, Emission and escape of neutrinos from the core of stars, Chandrashekhar limit and white dwarfs, Neutron star, Supernova, Origin of chemical elements.>>					
REFERENCES						
1.	Fundamental of Nuclear Physics – N. A. Jelley (Cambridge Univ. Press, 1990)					
2.	Introductory Nuclear Physics – K. S. Krane (Wiley India, 1988)					
3.	Nuclear Physics – Roy & Nigam (Wiley Eastern Ltd. 1979)					
4.	Atomic and Nuclear Physics – S. N. Ghoshal (S. Chand & Company)					
5.	Nuclear and Particle Physics – Burcham&Jobes (Addison Wesley, 1995)					
6.	Nuclear Physics in a Nutshell - Carlos A. Bertulani, Princeton Univ. Press					
7.	Fundamentals of Nuclear Physics, Jahan Singh, Pragati Publication					

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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		
<<M.Sc.>> : <<M.Sc. Physics>>						
YEAR	II	CORE: << PHY2311S01>> : << Condensed Matter Physics–I (Specialization Paper)>>			CREDIT	3
Semester	III				HOURS	45
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I	<<Title>>					15 hrs.
	<<CRYSTAL LATTICES: Primitive lattice vectors and primitive unit cell, Wigner-Seitz cell. Symmetry operations, proof for existence of rotational symmetries, Bravais and non-Bravais lattices, Two and three dimensional Bravais lattices and crystal systems. (Refs: Kittel, Ashcroft) RECIPROCAL LATTICES: Definition and properties, reciprocal lattices for simple cubic, body-centered cubic, face-centered cubic and simple hexagonal lattices. Ewald Sphere, Bragg’s law in reciprocal lattice, Bragg and von Laue formulations of X-ray diffraction, equivalence of two formulations. Miller indices of lattice planes and directions. (Refs: Kittel, Ashcroft, Ziman) >>					
UNIT-II	<<DIFFRACTION MEASUREMENTS>>					15 hrs.
	<<X-Ray crystallography, Ewald construction, X-ray diffraction methods (Laue, Single crystal & Powder), derivation of scattered wave amplitude, diffraction condition, scattering by an atom, Scattering by a unit cell, geometric structure factor and atomic form factor; Neutron diffraction –crystallography, Low Z element & Magnetic crystal structure determination; Low-energy electron diffraction – surface structure. (Refs: Kittel, Ashcroft)>>					
UNIT-III	<<TRANSPORT PHENOMENA >>					15 hrs.
	<<Drude theory of metals – DC and AC electrical conductivity, thermal conductivity, Wiedemann-Frantz law, Boltzmann equation, Relaxation time approximation, nonequilibrium distribution function, Sommerfeld Model, general transport coefficients, electronic conduction in metals, thermoelectric effects, transport phenomena in magnetic fields, Hall effect and quantum Hall effect, Temperature dependence of resistivity. (Refs: Ashcroft, Ziman)>>					
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.	Principles of the Theory of Solids by J. M. Ziman (2 nd Ed., Cambridge Univ. Press 1972; Asian Ed., Cambridge Univ. Press – New Delhi 2011)					

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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		
<<M.Sc.>> : <<M.Sc. Physics >>						
YEAR	II	CORE: << PHY2312S02>> : <<Condensed Matter Physics–II (Specialization Paper)>>			CREDIT	4
Semester	III				HOURS	60
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I	<<PHYSICS OF SEMICONDUCTORS AND DEVICES>>				15 hrs.	
	<<Cyclotron resonance and effective mass, Optical absorption in semiconductors, number of carriers in thermal equilibrium – intrinsic and extrinsic cases. Population of impurity levels in thermal equilibrium, p-n junction in equilibrium, Concept of Work function, contact potential, Thermionic emission, elementary picture of rectification by a p-n junction, general physical aspects of the nonequilibrium case. Schottky barrier cell, photovoltaic effect and solar cell, Gunn effect oscillator. (Refs: Kittel, Ashcroft)>>					
UNIT-II	<<ELECTRONIC ENERGY BANDS>>				15 hrs.	
	<<Review of free-electron model, density of states, Fermi energy, Fermi surface. Two proofs of Bloch’s theorem – from general quantum mechanical consideration and by explicit construction in a periodic potential, concept of Bloch wave vector and crystal momentum, Born-von Karman periodic boundary condition, number of allowed wave vectors in a Brillouin zone, Nearly free-electron model and tight-binding model, Concept of APW, OPW and LCAO methods, Pseudopotential theory. (Refs: Kittel, Ashcroft)>>					
UNIT-III	<<LATTICE DYNAMICS >>				15 hrs.	
	<<Harmonic and adiabatic approximations, lattice vibrations of three- dimensional crystals, periodic boundary conditions, normal modes, quantization of lattice waves – concepts of phonons and phonon momentum, lattice heat capacity (Einstein and Debye models), anharmonicity and thermal expansion, Grüneisen constant, lattice thermal conductivity – elementary kinetic theory, second sound, Experimental determination of phonon dispersion curve and phonon frequency. (Refs: Kittel, Ashcroft)>>					
UNIT-IV	<<ELASTIC CONSTANTS AND ELASTIC WAVES >>				15 hrs.	
	<<Geometric theory of strain, Displacement and strain components, Longitudinal and shearing strains, Finite strain, Dilational strain, Stress components, Elastic compliance constants and stiffness constants, Elastic energy density, Reduction of number of elastic constants, Elastic constants of cubic crystals, Cauchy’s relation, Elastic waves along principal directions in cubic crystals, Measurement of elastic constants. (Refs: Kittel, Ashcroft, Theory of Elasticity by L. D. Landau and E. M. Lifshitz)>>					
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.	Theory of Elasticity by L. D. Landau and E. M. Lifshitz)					

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<<Name of the Programme: M.Sc.>> : <<M.Sc. Physics >>					
YEAR	II	CORE: <<PHY2313S01>> : << ATOMIC & LASER SPECTROSCOPY-I (Specialization Paper)>>		CREDIT	3
Semester	III			HOURS	45
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	<< >>				15 hrs.
	<< Relativistic mass correction, hydrogen fine structure, Pauli’s exclusion principle(with treatment), determination of spectral terms for L–S and j-j coupling (atoms with one optical electron, atoms with two or more equivalent and non-equivalent optical electrons), selection rules for multi electron atoms in L-S and j – j coupling, Energy in one and two valence electron systems.>>				
UNIT-II	<<>>				15 hrs.
	<<General properties of laser, temporal coherence, spatial coherence (with analysis), mono-chromaticity of spectral lines, stimulated absorption and emission, calculation of Einstein’s coefficient and condition for sustain emission population inversion, meta stable state, three level and four level system pumping processes.>>				
UNIT-III	<< >>				15 hrs.
	<<Laser rate equation, threshold power, mode switching Shawlow - Towns condition, optical resonator, laser amplifier , laser safety, types of lasers:- CO2 laser, dye laser, semi conductor diode laser and free electron laser, applications of laser in industry, communication, laser induced fusion>>				
REFERENCES (Text Books)					
1.	Atomic Spectra by H.E.White, McGraw Hill.				
2.	Atomic and Molecular Spectra by Rajkumar, Kedar Nath Ram Nath, 2008.				
3.	Elements of Spectroscopy by Gupta, Kumar, Sharma, Pragati Prakasan,2007.				
4.	Laser Spectroscopy by W. Demtroder, 2nd Edition, Springer, 1998.				
5.	Laser Physics and Applications by L.Tarasov, Mir Publishers, Moscow,1986.				
6.	Lasers and Non- Linear Optics by B B Laud, Wiley Eastern Ltd, 1985.				
7.	Elements of Spectroscopy by Gupta, Kumar, Sharma, Pragati Prakasan,2007.				

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<<Name of the Programme: M.Sc.>> : <<M.Sc. Physics >>					
YEAR	II	CORE: <<PHY2314S02>> : <<MOLECULAR SPECTROSCOPY- I (Specialization Paper)>>		CREDIT	4
Semester	III			HOURS	60
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	<< >> << Electronic spectra of diatomic molecules, Hund’s coupling cases (a), (b), (c), symmetry properties of rotational levels, Evaluation of vibrational constants, combination relations and evaluation of rotational constants for a single headed and double headed band, isotopic effect in electronic bands.>>			15 hrs.	
	<< >> << Vibrational and rotational temperatures. Determination of term manifold from the states of separated atoms, united atoms and electron configuration, Types of electronic transitions, Vibrational and Rotational perturbations, diffuse molecular spectra, pre-dissociation.>>			15 hrs.	
UNIT-III	<< >> << Importance of molecular symmetry, symmetry elements and different types of symmetry operations : - identity, rotation, reflection, centre of inversion operation, rotation - reflection operation, molecular point groups, symmetry class, classification of point groups - non-axial, axial and dihedral.>>			15 hrs.	
	<< >> << IR Spectra of diatomic and poly atomic molecules, overtone and combination bands, normal mode of vibrations:- band stretching, angle deformation, rocking, wagging, twisting, out of plane and in-plane deformation, spectra of some simple molecules(H ₂ O, CO ₂ , NCS-, OCF ₂ , HNF ₂), Fermi resonance, skeletal and group frequency concept, coupled vibrations, interpretation of IR spectra, FTIR spectroscopy, instrumentation, sampling technique.>>			15 hrs.	
REFERENCES					
1.	Molecular Spectra and Molecular Structure, Vol.- I by G.Herzberg, Van Nostrand Co., N.Y.1950.				
2.	2. Atomic and Molecular Spectra by Rajkumar, Kedar Nath Ram Nath, 2008				
3.	3. Elements of Spectroscopy by Gupta, Kumar, Sharma, Pragati Prakasan,2007.				
4.	Introduction to Infrared and Raman Spectroscopy, by N B Colthup, L H Daly & S E Wiberley, 3rd Ed , Academic Press, 1990.				
5.	Vibrational Spectroscopy- Theory and Applications by D N Sathyanarayana, New age international publishers, 2000.				
6.	Infrared Spectroscopy: Fundamentals and Applications by B Stuart, John Wiley & sons. Ltd , 2004.				

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>					
YEAR	II	CORE: << PHY2303C15 >> : << PHYSICS LABORATORY-III >>		CREDIT	7
Semester	III			HOURS	
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
		<< List of experiments >> << List of experiments for students of Electronics & Communications Specialization:			
		- Operational Amp Applications – I - Logic Gate – I - Logic Gate – II - Regulated Power Supply - UJT Characteristics - Network Theorems - Operational Amplifier characteristics - Flip – Flop circuits - A to D converter - Microprocessor Programming – I - Integrating, Differentiating & clamping circuits			
		<u>List of experiments for students of Nuclear Physics Specialization:</u>			
		- Study of characteristics of G. M. Tube and determination of its Operating voltage, Plateau, Length/Slope, Dead time (single and double source method) and to study its variation with paralysis time. - To determine the efficiency of a GM counter using gamma source and also verify the Inverse Square Law using gamma & β - sources. - Linear and Mass absorption co-efficient of gamma rays using G.M. counter - (for aluminium, lead etc.). - To study the pulse height spectra and the resolution of a NaI Scintillator Detector - (Cs^{137}, Co^{60}, Mn^{54}, Co^{57}, Ba^{133}). - Study of the energy calibration of NaI Scintillator Detector and to determine the energy of unknown source. - To determine the Linear Absorption co-efficient of gamma rays using NaI Scintillator Detector and establish the relation between energy and linear absorption coefficient. - To study the Compton scattering using NaI (TI) detector. - Operational Amplifier as Adder, Subtractor, Inverter, Non-invetater, Integrator, Differentiator. (a) RC Pulse Shaping. (b) A/D & D/A Converter.			

	<u>List of experiments for students of Condensed Matter Physics Specialization:</u> 1. Stereographic Projection – I 2. Stereographic Projection – II 3. Cubic Crystal Models & Point Group Symmetry 4. Valde's Four Probe Method 5. Specific Heat of Graphite 6. Creep of Metals 7. Electrical Conductivity of Graphite 8. Crystalline & Non-crystalline Solid $\leftrightarrow$ Liquid Phase change 9. Conductivity - Pure Bi/Sb & Bi-Sb crystals 10. Hall Effect <u>List of experiments for students of Spectroscopy Specialization:</u> 1. Study of intensity variation in a diffraction pattern 2. Absorption spectrum of KMnO_4. 3. Study of polarization of light by optical elements 4. Divergence of Laser beam 5. Vibrational Analysis of CN molecule 6. Electronic Absorption Spectrum of I_2 molecule. 7. Rotation – Vibration Spectrum of AlO molecule 8. Vibrational spectrum of MgCl molecule 9. 1st & 2nd order spectrum of He / Ne - atom 10. Study of FTIR spectrum. 11. Michelson Interferometer 12. Fabry-Parrot Interferometer>>	
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