

CBCS-2019

Distribution of Credits for M. Sc. Physics Sem.- IV

Sr. No	Course code	Title of core courses	Credit
1	PHY2401C16	Quantum Mechanics & Statistical Mechanics	3
2	PHY2402C17	Classical Electrodynamics & Plasma Physics-II	4
3	PHY2403C18	Physics Laboratory-IV	6
4	PHY2404C19	Project & Viva	3
5	PHY2405C20	Advanced Research Techniques (24-25-PHY)	3
6	PHY2405E02	Experimental Techniques-II (Elective Paper)	3
7	PHY2406E02	Nanosceince & Biomaterials (Elective Paper)	3
8	PHY2407E02	Advanced Material Science (Elective Paper)	3
9	PHY2408S03	Electronics & Communications-III (Specialization Paper)	4
10	PHY2409S04	Electronics & Communications-IV (Specialization Paper)	3
11	PHY2410S03	Nuclear Physics – III (Specialization Paper)	4
12	PHY2411S04	Nuclear Physics – IV (Specialization Paper)	3
13	PHY2412S03	Condensed Matter Physics - III (Specialization Paper)	4
14	PHY2413S04	Condensed Matter Physics - IV (Specialization Paper)	3
15	PHY2414S03	Atomic & Laser Spectroscopy-II (Specialization Paper)	4
16	PHY2415S04	Molecular Spectroscopy-II (Specialization Paper)	3
Total			26

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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: << PHY2401C16 >> : << QUANTUM MECHANICS & STATISTICAL MECHANICS >>		CREDIT	3
Semester	IV			HOURS	45
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	<<>> << Scattering Theory:Asymptotic behaviour, Differential & total cross-section, Wave mechanical picture of scattering (scattering amplitudes), Green’s function: Formal expression for scattering amplitudes, Born approximation & its validity, Partial wave Analysis of Scattering: Partial waves, Asymptotic behaviour of partial waves (phase shifts), Scattering amplitudes in terms of phase shift, Differential and total cross-section (optical theorem), Relation between phase shift and potentials of finite range and formal expression for phase shift. Scatting by a rigid sphere & square well potential.>>				15 hrs.
	<<>> << Quantum Statistics:Review of Micro-canonical and grand -canonical ensembles, Grand canonical partition function, Derivation of BE Statistics, Weak and strong degeneracy, Application of BE statistics to BE condensation and phase transition. Thermodynamical properties of an ideal BE gas. Liquid He and its properties. Two fluid model of liquid He ⁴ .>>				
UNIT-II	<<>> << System of interacting bosons, elements of quantum theory of superfluidity. Electron gas in a metal. Field emission (uncorrected for image force). Screening of K electrons. Application of FD statistics to Pauli-paramagnetism and white dwarf, Ising model in 1-D, liquid He ³ >>				15 hrs.
	<<>> << Quantum Statistics:Review of Micro-canonical and grand -canonical ensembles, Grand canonical partition function, Derivation of BE Statistics, Weak and strong degeneracy, Application of BE statistics to BE condensation and phase transition. Thermodynamical properties of an ideal BE gas. Liquid He and its properties. Two fluid model of liquid He ⁴ .>>				
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REFERENCES					
1.	Quantum Mechanics- by E. Merzbacher John Wiley & Sons, New York 1868.				
2.	Quantum Mechanics - by B. K. Agrawal & Hari Prakash (PHIEEE, 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 Vol.-II by Ghatak & Loknathan				
5.	Statistical Mechanics - by K. Huang 2 nd Editions(John Wiley & Sons, 1987).				
6.	Statistical Mechanics - by F.Reif (International student ed. McGraw Hill 1988).				
7.	Statistical Mechanics - by R. K. Pathria, Elsevier publication				

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>					
YEAR	II	CORE: << PHY2402C17 >> : << CLASSICAL ELECTRODYNAMICS & PLASMA PHYSICS-II >>		CREDIT	4
Semester	IV			HOURS	60
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	<<>>				15 hrs.
	<<Solution of Maxwell's equations with nonzero ρ and j , scalar and vector potentials, Gauge transformations, Lorentz and Coulomb gauges, solution of inhomogeneous wave equation, retarded and advance Green function , retarded potentials. Non-relativistic multipole radiations: Electric dipole and quadruple radiations, Magnetic dipole radiation's, simple antenna problems, radiation resistance.>>				
UNIT-II	<<>>				15 hrs.
	<< Radiations by moving charges: LienardWeinchert potentials and field for a point charge, total power radiated by an accelerated charge (Larmor's Formula and its relativistic generalization). Angular distribution and frequency spectrum of the radiation power.Covariant formulation of electromagnetic theory: Mathematical properties of space time of special relativity, Matrix representation of Lorentz transformation,Invariance of electric charge, covariance of electrodynamics, Transformation of electromagnetic field (Lorentz force)>>				
UNIT-III	<<>>				15 hrs.
	<< Magnetohydrodynamics(MHD) and Plasma Physics: Introduction and definitions, MHD equations, Magnetic diffusion, viscosity and pressure, Magnetohydrodynamic flow between boundaries with crossed electric and magnetic fields, Magnetohydrodynamical waves, pinch effects. Instability in a pinched plasma column, High frequency plasma oscillations, short wave length limit of plasma oscillations and Debye-screening distance, >>				
UNIT-III	<<>>				15 hrs.
	<< Particle drift in non-uniform static magnetic fields, Magnetic mirrors, adiabatic invariance of flux through orbit of a particle, Two stream instability, Kinetic treatment of plasma oscillations and Landau damping physical explanation, Potentials and problems of controlled thermonuclear fusion, Ignition temperature and Lawson				

	criteria, Magnetic confinement, Simple discussion of Tokomak and Z-pinch, Ideas about inertial confinement and Laser fusion, Methods of plasma heating and problems of fusion.>>	
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. CompanyLtd.New Delhi 1990	
6.	Introduction to Plasma Physics and Controlled fusion :F. F. Chen. 2 nd Edition Plenum Press, New YorkLondon 1984	

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<<Name of the Programme: M.Sc.>> : <<M.Sc. Physics>>						
YEAR	II	CORE:			CREDIT	3
Semester	IV	<<PHY2405E02>> : <<EXPERIMENTAL TECHNIQUES-II>>			HOURS	45
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I	<<>>					15 hrs.
	<< Spectroscopy - X -ray Photoelectron spectroscopy(XPS); Ultra violet photo electron spectroscopy (UPS); X-ray emission (XES) and Absorption spectroscopy (XAS- XANES & EXAFS), Mossbouer Spectroscopy>>					
UNIT-II	<<>>					15 hrs.
	<< Rutherford Back Scattering (RBS),Positron Annihilation, PIXE, Auger electron spectroscopy (AES) ; X-ray Fluorescence Spectroscopy (XRF).>>					
UNIT-III	<<>>					15 hrs.
	< A.C. & D.C. Conductivity Measurements; Hall-effect measurements; Thermopower measurement; A.C. & D.C. Magnetic Susceptibility measurements; dielectric constant and dielectric loss tangent measurement; Introduction to Photoluminescence Techniques and Thermal Analysis technique.>>					
REFERENCES						
1.	Modern Techniques of Surface Science - by D.P. Woodruff & T.A. Delchar,Cambridge University Press, Cambridge.					
2.	Solid State Physics - by J.P.Srivastava.					
3.	Method of surface Analysis Ed. By J.M. Walls and V.G. Ionex UK, CAMBRIDGE UNIVERSITY PRESS (1989)					
4.	Modern Methods of Trace Element Analysis by MAURICE PINTA, ANN ARBOR SCIENCE Publ. Inc. Michiyon USA (1978)					

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<< M.Sc. >> : << M.Sc. Physics >>						
YEAR	II	CORE: << PHY2406E02 >> : << Elective Paper: Nanoscience & Biomaterials >>			CREDIT	3
Semester	IV				HOURS	45
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I	<<Title>>				15 hrs.	
	<<Introduction and applications of nanostructures and Nanomaterials, Confinement of electrons, quantization of energy bands and density states of quantum well, quantum wire, quantum dot, Carbon nanotubes, HOMO-LUMO gap, size-dependence of gap and dielectric constants and consequences size-dependence on various properties>>					
UNIT-II	<<Title>>				15 hrs.	
	<<Nanocomposite materials, Natural nanocomposite systems such as spider silk, cellulose, bones, man-made Nanocomposites through self-assembly. Bioelectronics, Conducting polymers, Synthesis of nanomaterials (Chemical, Physical, Biological methods), Nucleation kinetics and growth of Nanoparticles>>					
UNIT-III	<<Title>>				15 hrs.	
	<< Statistical description of living systems, transformation of energy, Osmosis, electrical potentials – action potential, redox potential and pH, Diffusion, Molecular machines and mechanisms, Thermal and mechanical properties of DNA and RNA – the genetic materials of life.>>					
REFERENCES						
1.	Introduction to Nanotechnology – Charles P. Poole Jr. and Franks J. Qwens					
2.	Handbook of Nanostructured Biomaterials and their Applications in nanobiotechnology -Hari Singh Nalwa					
3.	Nano composite Science & Technology Ajayan, Schadler & Braun					
4.	Introduction to Nanoscale Science and Technology (Nanostructure Science and Technology) - Massimiliano Di Ventra					
5.	Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H. Carola					
6.	Biological Physics – Energy, Information and Life by Phil Nelson. -W. H. Freeman & Co. Publishers					

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>						
YEAR	II	CORE: << PHY2407E02 >> : << Elective Paper: Advanced Materials Science >>			CREDIT	3
Semester	IV				HOURS	45
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I	<<>>				15 hrs.	
	<< Phase Diagrams: Phase rule, complete solid solution, Eutectic diagram with no solid solution, Eutectic diagram with limited solid solution, eutectoid diagram, peritectic General binary diagrams, Intermediate phases or intermetallic compounds, ceramic and ternary phase diagrams, phase transformations, Lever rule, Microstructural development, metals for nuclear energy Ceramics and glasses: Ceramics – crystalline materials, Glasses – noncrystalline materials, Glass-Ceramics, processing of ceramics and glasses>>					
UNIT-II	<<>>				15 hrs.	
	<< Polymers and composites: Polymerization, Structure of polymers, copolymers, polymer crystallinity, thermoplastic polymers, thermosetting polymers, additives and polymer processing, Fibre reinforced composites, conventional fiberglass, advanced composites, wood - a natural fibre reinforced composite, aggregate composites, property averaging in composites, electrical, thermal and mechanical properties and processing of composites, Quasicrystals, golden ratio, Fractals and aerogels>>					
UNIT-III	<<>>				15 hrs.	
	<< Ferromagnetism, ferrimagnetism, metallic magnets, soft and hard magnets, superconducting magnets, ceramic magnets, low conductivity and superconducting ceramic magnets, Giant Magnetoresistance and Colossal Megnetoresistance materials, Spintronic Materials Amorphous metals for electrical power distribution, thermoplastics versus thermosetting polymers, metal alloys for Flip-Chip technology, Light emitting diodes, conducting polymers, metallic glasses, shape memory alloys, non-linear materials, nanostructured materials>>					
REFERENCES						
1.	Materials Science for Engineers by <i>Shackelford J. F.</i> and <i>Muralidhara M. K.</i> , Dorling Kindersley (Ind) Pvt. Ltd., Noida, 6 th ed., 2007					
2.	Materials Science by <i>Kakani S. L.</i> and <i>Kakani Amit</i> , New Age International Publishers, N. Delhi, 2 nd ed., 2010					
3.	Elements of Solid State Physics by <i>J. P. Srivastava</i> , Prentice-Hall of India Private Limited, Delhi 2007, 2 nd Ed.					

		The Maharaja Sayajirao University of Baroda Faculty/College of Faculty of Science , Department of Physics		ACADEMIC YEAR 2024-2025	
Name of the Programme: M.Sc.-Physics					
YEAR	II	PHY2405C20 : Advanced Research Techniques		CREDIT	3
Semester	IV			HOURS	90
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	Experiments:				90 hrs.
	List of experiments: 1. FTIR spectrum analysis. 2. Raman spectrum analysis. 3. Vacuum sealing of various tubes. 4. Glass blowing of various tubes. 5. Meteorological observations and measurement. 6. Astronomical planets observation using astronomical Telescope. 7. Advanced Electronic circuit design and measurements. 8. Making of Pellets of different type of samples using Pelletiser. 9. Radiation detectors and measurements. 10. Development of computer program for least square fitting and error analysis . 11. HPGE Detector				

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<<Name of the Programme: M.Sc.>> : <<M.Sc. Physics>>						
YEAR	II	CORE:			CREDIT	4
Semester	IV	<<PHY2408S03>> : << Specialization Paper: ELECTRONICS & COMMUNICATIONS-III>>			HOURS	60
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I		<<>> << Frequency Modulation: Angle modulation, directly and indirectly modulated FM transmitters, angle modulation detectors, Foster Seeley discriminator, Phase locked loop discriminator. Pulse Modulation: Pulse amplitude modulation, pulse sampling theory, pulse width modulation, pulse position modulation, digital multiplexing.Radio: Radio receivers, Regenerative superheterodyne for AM and FM Receivers & Receiver Characteristics.>>				15 hrs.
UNIT-II		<<>> <<Satellite Transmission:Satellite uplink and Down Link, Satellite orbits, Station Keeping, Satellite Altitude, Transmission Path and its losses, Noise, Frequency and Propagation considerations, Communication link design Modulation, coding, Base band design, Multiple Access techniques, Communication satellites, Earth stations. Microwave Communication: Microwave Generators: Klystrons, velocity modulation process, bunching process, an apple gate diagram output power and efficiency of klystron and reflex klystron, dynatron operation of magnetron, Line of Sight (LOS) propagation: LOS propagation on flat earth, path clearance, Effect of ground, effect of nature of earth's surface, effect of atmosphere, ground based LOS, LOS microwave systemsLOS propagation on flat earth, path clearance.>>				15 hrs.
UNIT-III		<<>> <<Radio wave Propagation: Character of Ionosphere, effect of frequency on transmission, effect of ground on transmission, skip distance, Ionospheric refraction, maximum usable frequency, Virtual height and its determination. Antenna: Isotropic radiator, Antenna Action, Power gain, effective length of antenna, The Hertzian dipole, radiation resistance of an antenna, impedance matching, half wave dipole and quarterwave antenna, Brief description of- vertical antenna loop , ferrite rode, yagi-uda array, Microwave antenna: parabolic reflector and dielectric lens antenna.>>				15 hrs.

UNIT-IV	<<>>	15 hrs.
	<<Digital Modulation Techniques: Network hardware and Software-LAN, protocol hierarchies, design issues for the layers, Different Layers and their functions : OSI reference model, Physical Layer, Data Link Layer: Services provided to Network layer, Elementary ideas of framing, Ethernet, protocols, Token Bus, Token ring, Packet Switching, Integrating Services Digital Network (ISDN) system, its functioning and applications, Repeaters, Bridges and Gateways. Internetworking and Email Terminology: ISP, www, Web Page, Web Browser, Search Engines, IP address, Domain name, URL, TCP/IP, FTP.>>	
	REFERENCES	
1.	Communication systems, R. P. Singh and S. D. Sapre, TMH	
2.	Electronics communication systems, George Kennedy & Davis, Mc.Graw., Hill.	
3.	Electronic Communications, Roddey & Coolen, PHI	
4.	Active Inductor less Filters, by S. K. Mitra, IEEE Press 1971	
5.	Satellite Communication systems by M. Richharia, McGraw Hill, 1998	
6.	Communication Systems, R. P. Singh and S. D. Sapre, TMH	
7.	Principle of Communication Engineering By Anoke Singh , (S. Chand & Co. 1994)	
8.	Network lines and fields, J. D. Ryder, Asia Pub. House.	
9.	Hand Book of Electronics – Gupta and Kumar, Pragati Prakashan, Meerut	
10.	R.C.Johnson and H.Jasik, Antenna Engineering Handbook, McGraw Hill, 1984	
11.	R.E. Collin, Antennas and Radiowave propagation, McGraw Hill, 1985	
12.	Hand Book of Electronics – Gupta and Kumar	
13.	B.P. Lathi, Modern digital and analog communication systems	
14.	Proakis J.J. , Digital Communications, McGraw Hill	
15.	S. Tannenbaum, “Computer Networks”, PHI	
16.	Data Communication by P. Gupta, Tata McGraw Hill	

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>					
YEAR	II	CORE: << PHY2409S04 >> : << Specialization Paper: ELECTRONICS & COMMUNICATIONS-IV >>		CREDIT	3
Semester	IV			HOURS	45
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	<<>>			15 hrs.	
	<< Digital to analog Converter:Basic Summing Amplifier technique, Weighted D to A , BCD D/A Converter, Ladder R-2R network, 8 bit digital to analog converter, A to D Converter: Flash ADC and successive approximation ADC, Integrating ADC/Dual Slope A/D Converter Integrated Circuit 555 Timers: Operating modes and functioning of 555 timer, Astable, monostable operation, counters, Frequency divider, Ramp Generator, Timers circuits and applications, Linear IC regulators:3-pin voltage regulators with unregulated power supply, Adjustable three terminal positive and negative voltage regulators with Circuit analysis.>>				
UNIT-II	<<>>			15 hrs.	
	<< Interfacing: Interfacing Peripherals and Applications : Parallel I/O and Interfacing applications, General purpose Programmable Peripheral Devices: 8255A, 8253,8259A, DMA Controller, its architecture, control word, different modes of programming, Interfacing programs in assembly language, interfacing with memory and other peripheral devices.>>				
UNIT-III	<<>>			15 hrs.	
	<<Microprocessor Controlled Devices:Interfacing transducer to electronic controller and measuring systems. Microprocessor compatibility of ADC and DAC circuits, Interfacing of LEDs, Strain Gauge Transducer with 8085 μ P, Interface of Traffic Light signal, Interfacing of Stepper Motor, Interfacing of ADC 0800 series and analog multiplexer ADC, Interfacing of Digital to Analog devices - 0800 series.>>				
REFERENCES					
1.	Digital Technology by Virendra Kumar , New Age International				
2.	Fundamental of Electronics Devices by Milman and Halkias.				
3.	Fundamentalof electronics Devices by Milman and Halkias				
4.	Digital Technology by Tokheim – TMH				
5.	Electronic Devices –Floyd , Pearson Education				
6.	Solid State Pulse Circuits By David A. Bell , PHI				

7.	Microprocessor Architecture, Programming and Applications with 8085/8080A: R.S. Gaonkar, Penram Pub.
8.	Mircoprocessor Interfacing : Douglas Hall, McGraw Hill
9.	Microprocessor Architecture, Programming and Applications with 8085/8080A: Gaonkar, Penram Pub.
10.	Mircoprocessor Interfacing : Douglas Hall, McGraw Hill
11.	Microprocessor and Programming, B. Ram, Dhanpatrai Pub.

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		The Maharaja Sayajirao University of Baroda Faculty/College of << Faculty of Science >>, Department of << Physics >> <<Physics Department, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara - 390 002>>, << Phone : +91-265-2795339>>, <<>>			ACADEMIC YEAR 2019-2020	
<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>						
YEAR	II	CORE: << PHY2410S03 >> : << Specialization Paper: NUCLEAR PHYSICS–III >>			CREDIT	4
Semester	IV				HOURS	60
COURSE CONTENT / SYLLABUS						
UNIT-I		<< Nuclear Moments and Measurements >>				15 hrs.
		<<Nuclear size and radii, Methods for nuclear charge radius measurements, Nuclear potential radius, Nuclear magnetic moment, Gyromagnetic ratio, Larmor precession, Measurement of nuclear magnetic moment, Magnetic moment of proton and neutron, Nuclear statistics, Nuclear electric moment (electric dipole, quadrupole moments), Measurement of nuclear electric quadrupole moment.>>				
UNIT-II		<< Mossbauer Effect, Angular Correlation and High Spin State >>				15 hrs.
		<<Nuclear resonance fluorescence and absorption of gamma rays, Mossbauer Effect. Angular correlation of gamma rays, Gamma-gamma angular correlations. Perturbed angular correlation, Production and measurements of high spin states in heavy ion reactions, Kinematics, Back bending phenomena in high spin state.>>				
UNIT-III		<< Neutron Physics >>				15 hrs.
		<<Production and detection of neutrons, Time of flight method, Stability limit against spontaneous fission, Thermalization of neutrons, Dynamics of elastic scattering of neutrons, Angular distribution of neutrons, Average logarithmic decrement in energy of neutrons, Slowing down power and moderating ratio, slowing down density and time.>>				
UNIT-III		<< Reactor Physics >>				15 hrs.
		<<Thermal neutron diffusion and diffusion equation, Fast neutron diffusion and Fermi age equation, Critical size of reactor, critical size of reactors of different shapes, Nuclear reactor, Classification of reactors, Physical process in reactors, Nuclear fuel conversion, Nuclear materials employed in reactors, Nuclear power>>				
REFERENCES						
1.	Atomic and Nuclear Physics Vol-II, S. N. Ghosal.					
2.	Introduction to Nuclear Physics-Kenneth S. Krane					
3.	The Atomic Nucleus by R. D. Evans.					
4.	Introduction to Nuclear Physics by H. Enge.					
5.	Basic Nuclear Physics and Cosmic Rays by B. N. Srivastava.					
6.	Neutron Physics by Curtis					
7.	The Elements of Nuclear Reactor Theory- Glasstone and Edlund					
8.	Nuclear Reactor Engineering (4 th edn.,V-1),by S.Glasstone&A.Sesonske.					

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>					
YEAR	II	CORE: <<PHY2411S04>> : << Specialization Paper: NUCLEAR PHYSICS- IV>>		CREDIT	3
Semester	IV			HOURS	45
COURSE CONTENT / SYLLABUS					
UNIT-I	<< Nuclear Reactions I >>				15 hrs.
	<<Rutherford scattering, Optical model for elastic scattering, Coulomb excitations; Stripping and pick-up reactions using Born approximation, Thermonuclear fusion reaction. Qualitative ideas on deep inelastic electron-proton scattering, Bjorken scaling and the parton model.>>				
UNIT-II	<< Nuclear Reactions II >>				15 hrs.
	<<Physical description of heavy ion interaction, elementary ideas of classical and quantum mechanical theories, Classical and semi-classical analysis of heavy ion reaction data, Complete and incomplete fusion reactions, Idea of sub-barrier fusion, Stability of heavy nuclei, Super heavy elements>>				
UNIT-III	<< Particle Physics >>				15 hrs.
	<<Invariance in relation to particle reactions and decays, Ideas of C, P and T symmetries, Lie groups generators, representation and products of representation, SU(2) and SU(3) groups, Light mesons and baryons in quark model. Charm, bottom and top quarks, CP violation, Spontaneous symmetry breaking and Higgs mechanism.Standard model for electroweak unification (in brief)>>				
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.	Introduction to High Energy Physics – D.H. Perkins (Cambridge Univ. Press, 4th Ed.)				
6.	Quarks and leptons – Halzen& Martin (John Wiley & Sons, 1984)				
7.	Nuclear and Particle Physics – Burcham&Jobes (Addison Wesley, 1995)				
8.	Nuclear Physics in a Nutshell - Carlos A. Bertulani, Princeton Univ. Press				
9.	Nuclear Physics by V.Devanathan				

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<< M.Sc. >> : << M.Sc. Physics >>							
YEAR	II	CORE: <<PHY2412S03>> : <<Condensed Matter Physics – III (Specialization Paper)>>				CREDIT	4
Semester	IV					HOURS	60
OBJECTIVES:							
COURSE CONTENT / SYLLABUS							
UNIT-I	<<Title>>					15 hrs.	
	<< NONCRYSTALLINE SOLIDS: Diffraction pattern, Mono and Di atomic amorphous materials, Radial distribution function, Glasses, Amorphous Ferromagnets and Semiconductors, Low energy excitations in amorphous solids, Fiber optics. (Refs: Kittel) ALLOYS: General concept of alloys, Substitutional solid solutions- HUME-ROTHERY rules, order-disorder transformations, phase diagrams, transition metal alloys, Kondo effect. (Refs: Kittel)>>						
UNIT-II	<<Title>>					15 hrs.	
	<< MAGNETIC PROPERTIES: Magnetic properties of insulators, Langevin diamagnetism and Van Vleck paramagnetism, Curie paramagnets and Curie-Weiss ferromagnets, Neel antiferromagnets, Heisenberg model, spin waves, Ising model, elements of magnetic properties of metals, Landau diamagnetism, Stoner ferromagnetism, magnetic resonance. (Refs: Kittel, Ashcroft, Kantorovich) MAGNETIC FIELD EFFECTS IN METALS: Motion of a charged particles in a uniform magnetic field, Landau levels of Bloch electrons and origin of the oscillatory phenomena, de Haas-van Alphen effect and Fermi surface measurement, effect of electron spin (Refs: Kittel, Ashcroft, Ziman, Quantum Mechanics – Nonrelativistic by L. D. Landau & E. M. Lifshitz)>>						
UNIT-III	<<Title>>					15 hrs.	
	<< OPTICAL PROCESSES AND EXCITONS Optical Reflectance: Kramers-Kronig relations, Example: Conductivity of collisionless Electron Gas, Electronic Interband Transitions. Excitons: Frenkel Excitons, Alkali Halides, Molecular Crystals, Weakly Bound (Mott-Wannier) Excitons.						

	PLASMONS, POLARITONS AND POLARONS Dielectric Function of the Electron Gas: Definitions of the Dielectric Function, Dispersion Relation for Electromagnetic Waves, Transverse Optical Modes in a Plasma, Transparency of Metals in the Ultraviolet, Longitudinal Plasma Oscillations; Plasmons: Electrostatic Screening, Screened Coulomb Potential, Mott Metal-Insulator Transition; Polaritons: LST Relation,Electron-Electron Interaction,Fermi-Liquid, Electron-Phonon interaction-Polaron. (Refs: Kittel, Ashcroft)>>	
UNIT-IV	<< MANY-ELECTRON PROBLEMS IN SOLIDS >>	15 hrs.
	<<Hartree equations, Hartree-Fock equations, Hartree-Fock theory of free electrons, screening effects, Thomas-Fermi and Landau theory of screening, Landau Fermi-Liquid theory (elementary aspects) and Quasiparticles. (Refs: 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.	Quantum Theory of the Solid State: An Introduction by Lev Kantorovich (Kluwer Academic, 2004).	
4.	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)	
5.	Quantum Mechanics – Nonrelativistic by L. D. Landau & E. M. Lifshitz	

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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:			CREDIT	3	
Semester	IV	<< PHY2413S04 >> : << Condensed Matter Physics – IV (Specialization Paper) >>			HOURS	45	
OBJECTIVES:							
COURSE CONTENT / SYLLABUS							
UNIT-I		<< SURFACE, INTERFACE AND NANOSTRUCTURE PHYSICS >> << Surface Electronic Structure: Work Function, Thermionic Emission, Surface States, Magnetoresistance in a Two-Dimensional Channel: Introduction to Integral Quantized Hall Effect (IQHE), IQHE in real systems. Electronic Structure of 1D systems: One-Dimensional Subbands, Spectroscopy of Van Hove Singularities, 1D Metals-Coulomb interactions and Lattice couplings. Electrical Transport in 1D: Conduction Quantization and the Landauer Formula, Two barriers in Series-resonant tunneling, Incoherent addition and Ohm's Law, Localization, Electronic structure of 0D systems: Quantized Energy Levels, Semiconductor Nanocrystals, Metallic Dots. Electrical Transport in 0D: Coulomb Oscillations, Spin, Mott Insulators and the Kondo Effect. Vibrational and Thermal Properties of Nanostructures: Quantized Vibrational Modes, Transverse Vibrations. (Refs: Ashcroft: Chap. 18; Harrison,; Physical Properties of Carbon Nanotubes by R. Saito, G. Dresselhaus and M. S. Dresselhaus, World Scientific; Graphene- Carbon in two-dimensions by M. I. Katsnelson, Cambridge Univ. Press.)>>				15 hrs.	
UNIT-II		<< SUPERCONDUCTIVITY >> <<Electron-phonon interaction, Electron-electron interaction via exchange of bosons, binding energy of a cooper pair, ground state of superconducting electron gas, gap-equation, transition temperature and isotope effect, Josephson tunneling, elements of high T _c - Superconductivity. (Refs: Tilley & Tilley, Chap. 11 for High-T _c ; Ashcroft, Kittel)>>				15 hrs.	
UNIT-III		<< CRYSTAL GROWTH AND THIN FILM GROWTH >> <<Crystal Growth and its Techniques: Nucleation kinetics, Homogeneous and Heterogeneous Nucleation, Interface controlled growth, Surface nucleation and layer growth mechanisms, Real crystals and role of screw dislocations. Solution, Melt (Zone melting method, Bridgman method, Czochralsky method) and vapour growth methods. Thin Films and Properties: Stages of thin film growth, Thickness measurement by interference techniques, Tolansky technique, Thickness monitoring by crystal Oscillator, Film adhesion to the substrate and its measurement, Sheet resistant. (Ref.: Crystal Growth Process - J.C.Baxi., Art and Science of Growing crystals - J.J. Gilman, Handbook of Thin Film Technology.-Meissel and Glang, Thin Film Phenomena - K. L Chopra)>>				15 hrs.	

REFERENCES	
1.	Solid State Physics by N. W. Ashcroft and N. D. Mermin (2 nd Ed., Holt-Saunders, 2000).
2.	Quantum Wells, Wires and Dots by P. Harrison (Wiley & Sons, 2005).
3.	Physical Properties of Carbon Nanotubes by R. Saito, G. Dresselhaus and M. S. Dresselhaus, World Scientific; Graphene- Carbon in two-dimensions by M. I. Katsnelson, Cambridge Univ. Press.
4.	Superfluidity and Superconductivity by D. R. tilley and John Tilley (3 rd Ed, Overseas Press – Indian Edition, 2005).
5.	Solid State Physics by N. W. Ashcroft and N. D. Mermin (2 nd Ed., Holt-Saunders, 2000)
6.	Introduction to Solid State Physics by Charles Kittel (8 th Ed., Wiley Eastern, 2004).
7.	Crystal Growth Process - J.C.Baxi., Art and Science of Growing crystals - J.J. GilmanHandbook of Thin Film Technology.-Meissel and Glang, Thin Film Phenomena - K. L Chopra

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>						
YEAR	II	CORE: << PHY2414S03 >> : << Specialization Paper: ATOMIC & LASER SPECTROSCOPY-II >>			CREDIT	4
Semester	IV				HOURS	60
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I	<<>>				15 hrs.	
	<< Explanation of normal and anomalous Zeeman effect, examples of Zeeman splitting in some transitions ($1F \rightarrow 1D$, $2D \rightarrow 2P$ and $3P \rightarrow 3S$), Paschen-Back effect, Stark effect in hydrogen (weak and strong field), Zeeman effect in hyperfine structure (inclusive quantum mechanical treatment), Back-Goudsmit effect in hyperfine structure, 21cm line due to nuclear spin transition line and its detection (natural population inversion). Fine structure in X-ray emission spectra, screening doublets, spin – relativity doublets, regular and irregular doublets law, satellites, structure of absorption edges.>>					
UNIT-II	<<>>				15 hrs.	
	<< Raman Spectra: selection rules, depolarization ratio, Raman band intensities, rotation and vibration-rotation Raman spectra, resonance Raman effect, non- linear Raman effects - stimulated Raman effect, hyper Raman effect, Coherent Anti-Stokes Raman Scattering(CARS), instrumentation, sample handling techniques, interpretation of Raman spectra.>>					
UNIT-III	<<>>				15 hrs.	
	<<Intra cavity control of spectral characteristics, Single mode operation, Multi mode operation, Methods of Q-Switching – Acousto-optic and passive, Pulsed lasing, methods of mode locking, optical mixing, frequency tuning by parametric oscillation , wave front correction of laser output, Light beam manipulation, Mode pulling, Hole burning.>>					
UNIT-IV	<<>>				15 hrs.	
	<<Harmonic generation, phase matching, second harmonic generation, third harmonic generation, fourth harmonic generation, intra-cavity absorption, photo-acoustic spectroscopy, photo-thermal deflection spectroscopy, opto-galvanic spectroscopy, two photon and multi photon absorption.>>					
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.	Modern Raman Spectroscopy - A Practical Approach by W E Smith & G Dent, John Wiley & sons. Ltd , 2005.
5.	Introduction to Infrared and Raman Spectroscopy, by N B Colthup, L H Daly & S E Wiberley, 3 rd Ed , Academic Press, 1990.
6.	Lasers & Non- Linear Optics by B B Laud, Wiley Eastern Limited, 1985
7.	Laser Spectroscopy by W. Demtroder, 2 nd Edition, Springer, 1998.
8.	Lasers and Non- Linear Optics by B B Laud, Wiley Eastern Ltd, 1985
9.	Laser Physics and Applications by L.Tarasov, Mir Publishers, Moscow,1986.

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>						
YEAR	II	CORE: << PHY2415S04 >> : << Specialization Paper: MOLECULAR SPECTROSCOPY-II >>			CREDIT	3
Semester	IV				HOURS	45
OBJECTIVES:						
COURSE CONTENT / SYLLABUS						
UNIT-I	<<>>				15 hrs.	
	<< Electronic spectra of polyatomic molecules, change of shape on excitation, chemical analysis by electronic spectroscopy, rotational fine structure of vibronic transitions, determination of LCAO Coefficients, overlap and resonance integrals, Intensity and oscillator strength of vibronic spectra, vibronic interaction (Renner-Teller effect), Jahn-Teller effect.>>					
UNIT-II	<< Radio astronomy >>				15 hrs.	
	<<Introduction, Basic definitions, Radio telescopes, Interferometry and aperture synthesis telescope, Determination of the structure of radio source, Radiation processes, Radio emission in our galaxy, Brief of the milky way, radio galaxies, Quasars and Blazars, Pulsars, Radio spectra and structure>>					
UNIT-III	<<>>				15 hrs.	
	<<Radio astronomy and Cosmology, introduction to cosmological models (Friedmann-Robertson Walker), Hubble's law, red-shift, cosmic microwave background radiation (CMBR), WMAP (Wilkinson Microwave Anisotropy probe), Implications of CMBR and WMAP for modern cosmology>>					
REFERENCES						
1.	Astrophysics - A Modern Perspective by K.S. Krishnaswamy, New Age International Publishers, 1996. (Reprint 2008/2009)					
2.	Introduction to cosmology by J V Narlikar 3 rd Cambridge Indian Edition, 2003.					
3.	Astrophysics: Stars and galaxies by K D Abhyankar, Univ. press, H'bad, 2001.					

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<<Name of the Programme: M.Sc. >> : << M.Sc. Physics >>					
YEAR	II	CORE: << PHY2403C18 >> : << Physics Laboratory-IV >>		CREDIT	6
Semester	IV			HOURS	75
OBJECTIVES:					
COURSE CONTENT / SYLLABUS					
UNIT-I	<< List of experiments >>				
	<< <u>List of experiments for students of Electronics & Communications Specialization:</u> 1) SCR Characteristics 2) FET Amplifier 3) Adder & Subtractor 4) Up & Down counter 5) 555 Timer 6) Multiplexing and demultiplexing, SRAM 7) Operational Amplifier - II 8) AM & FM Demodulation 9) μ Processor Programming - II 10) LVDT, Strain gauge, load Cell 11) Interfacing Peripherals with μ processor. 12) Active Filters <u>List of experiments for students of Nuclear Physics Specialization:</u> 1)Study of Back Scattering of β -particle using G. M. counter with different materials. 2) Study the random nature of radioactive decay by G. M. counter. 3) Study of Feather analysis by G. M. counter. 4) Range of α -particles (Am-241) in air and polymer using alpha detector. 5) Determination of absolute efficiency of NaI (Tl) Scintillation detector using standard sources. 6) Determination of the activity of a gamma source using NaI (Tl) detector. 7) Analysis of efficiency spectrum of Ge detector using ^{152}Eu standard source. 8) To study the working of an active low and high pass filter circuits 9)To study the transistor co-incidence circuit.				

	<u>List of experiments for students of Condensed Matter Physics Specialization:</u> 1) Optical Band Gap 2) Single Crystal Rotation – X-ray diffraction 3) Laue Method 4) X-Ray Powder Method 5) Intensity of X-Ray Diffraction (Powder Pattern) 6) Powder Diffraction Pattern – Graphical Analysis 7) Electron Diffraction 8) Ionic Conductivity of Alkali Halide Crystal 9) Dielectric Constant 10) Use of RL: Non-cubic crystal projection <u>List of experiments for students of Spectroscopy Specialization:</u> 1) Salt analysis by spectroscopic method. 2) Isotopic shift in AgCl molecule. 3) Rotational analysis of CN molecule. 4) Doppler broadening. 5) Waist of laser. 6) Rotational temperature of PbO molecule. 7) Rotational analysis of CO molecule. 8) Raman Spectrum of CCl₄. 9) UV – Vis Spectrum analysis. 10) Solar Spectrum analysis. 11) Brightness of night sky. 12) Study of (a) Lunar craters (b) Sun spots.>>	
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