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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics	ACADEMIC YEAR 2020-2021

B.Sc. Physics Programme

Year	II	**Principal Group /~~Core/Elective/Foundation~~** **PHY1301PT : OPTICS AND LASERS**	Credit / Hrs per week	4
Semester	III	Year of Introduction: 2020-2021		
Theory/~~Lab~~		Year of Syllabus Revision:	Max marks	100

Objectives	1. Learn basic concepts of **OPTICS AND LASERS Physics** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	Concept of Interference**,** Techniques of obtaining interference, Young's Double Slit experiment-wavefront division, Condition for interference, Lloyd's Mirror, Fresnel's Biprism, Non-localized fringes. **Interference in Thin Films:** Plane parallel film, Interference due to transmitted light, Haidinger Fringes, Wadge shaped film, Newton's Rings. **Michelson's Interferometer:** Principle, Construction, Working, Circular fringes, Localized fringes, White light fringes, Visibility of fringes, Applications of Michealson's Interferometer, Fabry-Perot Interferometer and etalon. **Illustrative Problems**	25
Unit-2	**Diffraction**: Concept of diffraction, Fresnel diffraction, Huygens-Fresnel theory, Fresnel's assumptions, Difference between interference and diffraction. Fresnel and Fraunhoffer types of diffraction, Fresnel Diffraction pattern of a straight edge. Fraunhoffer diffraction at double slit. **Polarization:** Unpolarized and Polarized light,Types of Polarization**,** Production of plane polarized light, Polarizer and analyzer, Anisotropic crystal, Nichol prism, Double refraction in calcite crystal, Quarter wave plate, Babinet compensator, Application of polarized light. **Illustrative Problems**	25
Unit-3	Resolving Power, Rayleigh's Criterion, Limit resolution of eye,Limit resolution of a convex lens, Resolving power of optical instrument, Criterion for resolution according to Lord Rayleigh, Resolving power of telescope, Resolving power of microscope, Resolving power of grating, Resolving power of a prism, Magnification versus resolving power, Michealson's stellar interferometer. **Illustrative Problems**	25
Unit-4	Attenuation of light in an optical medium, Thermal equilibrium, Interaction of light with matter, Absorption, Spontaneous emission, Einstein's prediction, Stimulated	25

	emission, Einstein relations, Light amplification, condition for stimulated emission to dominate spontaneous emission and absorption, population inversion, active medium, pumping methods, meta-stable states, principle of pumping schemes-three and four level scheme, optical resonant cavity, lasing action, Ruby laser, Nd-YAG Laser,He-Ne Laser, Carbon dioxide Laser, P-N Junction Laser, Laser beam characteristics and applications. **Illustrative Problems**	

REFERENCES

1.	A Textbook Optics, Dr. N. Subrahmanyam, Brijlal, Dr. M. N. Avadhanulu, 2015, S. Chand & Comp. Pvt. Ltd.
2.	Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
3.	Principles of Optics, B.K. Mathur, 1995, Gopal Printing
4.	Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications
5.	University Physics. F.W. Sears, M.W. Zemansky and H.D. Young. 13/e, 1986. Addison-Wesley.

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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics	ACADEMIC YEAR 2020-2021

B.Sc. Physics Programme

Year	II	**Principal Group /~~Core~~/~~Elective~~/~~Foundation~~** **PHY1302PT : Electronics**	Credit / Hrs per week	4
Semester	III	Year of Introduction: 2020-2021		
Theory/~~Lab~~		Year of Syllabus Revision:	Max marks	100

Objectives	1. Learn basic concepts of **Electronics** **Physics** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Employability/Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**Digital Circuits:** **Number System:** Binary, Hex, Octal and BCD, addition, subtraction, multiplication of binary numbers, decimal numbrs, 2's complement, conversion of numbers, binary to gray and ASCII codes, Parity checkDifference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuitusing Boolean Algebra.FundamentalProducts.Min-termsandMaxterms.Conversionofa Truth Table into an Equivalent Logic Circuit by Sum of Products Method.	25
Unit-2	**Semiconductor Devices and Amplifiers:**	25

	Semiconductor Diodes: P and N type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell. Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line & Q-point. Active, Cutoff & Saturation regions. Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit. Analysis of single-stage CE amplifier using hybrid Model. Input & output Impedance. Current, Voltage and Power gains. Class A, B & C Amplifiers	
Unit-3	**Operational Amplifiers (Black Box approach) and Digital Electronics:** Operational Amplifier: Characteristics:- Concept of Differential mode, Input off set voltage, Common mode rejection ratio, Bias Current, Input off set current, slew rate, input-output impedance, negative feedback in Op-Amp, Inverting, non-inverting, Summing, voltage follower, zero level detector & Comparator circuit analysis. Digital Electronics:- Binary number System its Conversion to decimal hexdecimal and octal system and vice versa, BCD code, Excess-3code, Gray code. Digital gates, Buffers and other gate formation by universal gates, Boolean algebraic laws and De Morganization, Simplification of Boolean algebraic expressions, Parity generator and parity checker.	25
Unit-4	**Instrumentations:** Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation.	25

REFERENCES

1.	Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2.	Digital Technologies by VirendraKumar New Age International, India
3.	Microelectronic Circuits, M.H. Rashid, 2nd Edn., 2011, Cengage Learning.
4.	Modern ElectronicInstrumentation and Measurement Tech., Helfrickand Cooper,1990, PHI Learning
5.	DigitalPrinciplesandApplications,A.P.Malvino,D.P.LeachandSaha,7th Ed., 2011, Tata McGraw Hill
6.	Fundamentals ofDigital Circuits, A. AnandKumar, 2nd Edition, 2009, PHILearning Pvt. Ltd.
7.	OP-AMP & Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics	ACADEMIC YEAR 2020-2021

B.Sc. Physics Programme

Year	II	**Principal Group /~~Core~~/~~Elective~~/~~Foundation~~** **PHY1303PL : PHYSICS PRACTICALS-III**	Credit / Hrs per week	4
Semester	III	Year of Introduction: 2020-2021		
~~Theory~~/Lab		Year of Syllabus Revision:	Max marks	100

Objectives	1. Learn basic concepts of _____ **Physics** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**<u>List of Experiments:</u>** **Optics experiments:** 1. Air wedge 2. Diffraction grating 3. Resolving power of diffraction grating 4. Bi-prism 5. Optical lever 6. Double refraction 7. Cauchy's constant **Electronics:** 1. Measurement of voltage and frequency of periodic wave form using CRO 2. Logic gates 3. Adder circuits 4. IV characteristics of Zener diode and LED 5. CE amplifier 6. Transistor-I 7. Transistor-II 8. OPAM 9. Design of filter circuits	100

REFERENCES

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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics	ACADEMIC YEAR 2020-2021

B.Sc. Physics Programme

Year	II	~~**Principal Group /Core**~~ **/ Generic Elective /** ~~**Foundation**~~ **PHY1301ET : OPTICS AND LASERS**	Credit / Hrs per week	3
Semester	III	Year of Introduction: 2020-2021		
Theory/~~Lab~~		Year of Syllabus Revision:	Max marks	100

Objectives	1. Learn basic concepts of **OPTICS AND LASERS** **Physics** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**Interference:**Concept of Interference**,** Techniques of obtaining interference, Young's Double Slit experiment-wavefront division, Condition for interference, Fresnel's Biprism. **Interference in Thin Films:** Plane parallel film, Interference due to transmitted light, Haidinger Fringes, Wadge shaped film, Newton's Rings. **Diffraction**: Concept of diffraction, Fresnel diffraction, Huygens-Fresnel theory, Difference between interference and diffraction. **Polarization:** Unpolarized and Polarized light,Types of Polarization**,** Production of plane polarized light, Polarizer and analyzer, Anisotropic crystal, Nichol prism, Double refraction in calcite crystal. **Illustrative Problems**	33.33
Unit-2	**Resolving Power:** Resolving Power, Rayleigh's Criterion, Limit resolution of eye,Limit resolution of a convex lens, Resolving power of optical instrument, Criterion for resolution according to Lord Rayleigh, Resolving power of telescope, Resolving power of microscope, Resolving power of grating, Resolving power of a prism, Magnification versus resolving power. Eye piece: Huygens eyepiece, Gauss eyepiece. **Illustrative Problems**	33.33
Unit-3	**LASERS:** Attenuation of light in an optical medium, Thermal equilibrium, Interaction of light with matter, Absorption, Spontaneous emission, Einstein's prediction, Stimulated emission, Einstein relations, Light amplification, condition for stimulated emission to dominate spontaneous emission and absorption, population inversion, active medium, pumping methods, meta-stable states, principle of pumping schemes-three and four level scheme, optical resonant cavity, lasing action, Ruby laser,He-Ne	33.33

	Laser, P-N Junction Laser, Laser beam characteristics and applications. **Illustrative Problems**	

REFERENCES

1.	A Textbook Optics, Dr. N. Subrahmanyam, Brijlal, Dr. M. N. Avadhanulu, 2015, S. Chand & Comp. Pvt. Ltd.
2.	Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
3.	Principles of Optics, B.K. Mathur, 1995, Gopal Printing
4.	Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications
5.	University Physics. F.W. Sears, M.W. Zemansky and H.D. Young. 13/e, 1986. Addison-Wesley.

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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics	ACADEMIC YEAR 2020-2021

B.Sc. Physics Programme

Year	II	**~~Principal Group /Core~~/ Generic Elective/~~Foundation~~** **PHY1302EL: PHYSICS PRACTICALS (EG) - I**	Credit / Hrs per week	1
Semester	III	Year of Introduction: 2020-2021		
~~Theory~~/Lab		Year of Syllabus Revision:	Max marks	100

Objectives	1. Learn basic concepts of _____ **Physics** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**<u>List of Experiments:</u>** **Optics experiments:** 1. Air wedge 2. Diffraction grating 3. Resolving power of diffraction grating 4. Bi-prism 5. Optical lever 6. Double refraction 7. Cauchy's constant	100

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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics	ACADEMIC YEAR 2020-2021

B.Sc. Physics Programme

Year	II	~~**Principal Group /Core**~~**/ Generic Elective/**~~**Foundation**~~ **PHY1303ET : Electronics**	Credit / Hrs per week	3
Semester	III	Year of Introduction: 2020-2021		
Theory/~~Lab~~		Year of Syllabus Revision:	Max marks	100

Objectives	1. Learn basic concepts of **Electronics** **Physics** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**Digital Circuits:** **Number System:** Binary, Hex, Octal and BCD, addition, subtraction, multiplication of binary numbers, decimal numbrs, 2's complement, conversion of numbers, binary to gray and ASCII codes, Parity checkDifference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuitusing Boolean Algebra.FundamentalProducts.Min-termsandMaxterms.Conversionofa Truth Table into an Equivalent Logic Circuit by Sum of Products Method.	33.33
Unit-2	**Semiconductor Devices and Amplifiers:** Semiconductor Diodes: P and N type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell. Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line & Q-point. Active, Cutoff & Saturation regions. Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit. Analysis of single-stage CE amplifier using hybrid Model. Input & output	33.33

	Impedance. Current, Voltage and Power gains. Class A, B & C Amplifiers.	
Unit-3	**Instrumentations:** Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation	33.33

REFERENCES

1.	Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2.	Digital Technologies by VirendraKumar New Age International, India
3.	Microelectronic Circuits, M.H. Rashid, 2nd Edn., 2011, Cengage Learning.
4.	Modern Electronic Instrumentation and Measurement Tech., Helfrickand Cooper,1990, PHI Learning
5.	DigitalPrinciplesandApplications,A.P.Malvino,D.P.LeachandSaha,7th Ed.,2011, Tata McGraw Hill
6.	Fundamentals ofDigital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
7.	OP-AMP & Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics	ACADEMIC YEAR 2020-2021

B.Sc. Physics Programme

Year	II	~~**Principal Group / Core**~~**/ Generic Elective/**~~**Foundation**~~ **PHY1304EL: PHYSICS PRACTICALS (EG) - II**	Credit / Hrs per week	1
Semester	III	Year of Introduction: 2020-2021		
~~Theory~~/Lab		Year of Syllabus Revision:	Max marks	100

Objectives	1. Learn basic concepts of _____ **Physics** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**<u>List of Experiments:</u>** **Electronics:** 1. Measurement of voltage and frequency of periodic wave form using CRO 2. Logic gates 3. Adder circuits 4. IV characteristics of Zener diode and LED 5. CE amplifier 6. Transistor-I 7. Transistor-II 8. OPAM 9. Design of filter circuits	100

REFERENCES

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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics	ACADEMIC YEAR 2020-2021

B.Sc. Physics Programme

Year	II	~~**Principal Group /Core/Elective**~~**/Foundation** **PHY1001FT : Nano Science**	Credit / Hrs per week	2
Semester	III	Year of Introduction: 2018-2019		
Theory~~/Lab~~		Year of Syllabus Revision: 2020-2021	Max marks	50

Objectives	1. Learn basic concepts of **Nano science** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Employability/Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**Fundamentals of Nanoscience:** Definitions, Nano scopic Colours (Butterfly Wings), Bioluminescence (Fireflies), Tribiology (Geckos sticky feet, lotus leaf effect), Introduction to hydrophilic and hydrophobic materials, Nanotechnology timeline, Uniqueness of the nano scale, Future perspectives of nano science and nanotechnology, Inter conversion of units, Introduction to surface area to volume ratio and aspect ratio. Difference between surface area to volume ratio of bulk materials and nanomaterials (sphere, hollow, rods, hollow rods, cubes and hollow cubes) and related numerical problems. Mechanical, thermal, optical and magnetic properties	50
Unit-2	**Classification of Nanomaterials:** Nanomaterials and wavelength of light, Brief introduction to dimensional growth process and classification of nanomaterials into 0 D, 1 D, 2 D and 3 D. (Quantum dots, Quantum wires, Carbon nanotubes, Bucky balls, Fullerenes). Fundamentals of nanoscale self-assembly process involved in important functional biomoleculessuch as Nucleic acid (DNA and RNA), Proteins, Enzymes, Cell structure and organelles, nanoscale assembly of cellular components (cell membrane and liposomes), Nanoscale assembly of microorganisms (virus). Applications: electronic, biotechnology and Medical, Automobiles, Space, Defence, Sports, Cosmetics.	50

REFERENCES

1.	Nanotechnology: principles and Practices by Sulbha K Kulkarni, Capital Publishing Co. New Delhi
2.	Introduction to Nanoscience and Nanotechnology, KK Chattopadhya and A N Banerjee, PHI learning Pvt Ltd. 2012
3.	Introduction to Nanotechnology, C.P. Poole Jr. and F.J. Ownes, Wiley
4.	Essentials in Nanoscience and Nanotechnology, N Kumar and SunitaKumbhat, Wiley
5.	Nanostructures and Nanomaterials, G Cao and Y Wang, World Scientific
6.	Nanomaterials, B. Viswanathan, Narosa
7.	Introduction to nanoscience and nanotechnology, CRC Press, Tylor and Francis Group, Boca Raton,

	G. L. Hornyak, H. F. Tibbals, J. Dutta and J J. Moore.
8.	Introductory Nanoscience: Physical and Chemical Concepts, CRC Press, Tylor and Francis Group, Boca Raton, M. Kuno.

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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics		ACADEMIC YEAR 2020-2021	
B.Sc. Physics Programme				
Year	II	~~**Principal Group /Core/Elective**~~**/Foundation** **PHY1002FT : Biophysics**	Credit / Hrs per week	2
Semester	III	Year of Introduction: 2018-2019		
Theory/~~Lab~~		Year of Syllabus Revision: 2020-2021	Max marks	50

Objectives	1. Learn basic concepts of **Biophysics** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Employability/Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**Concepts of Bio Physics:** Concepts of classical physics at Limitation, Quantum principles of Atomic structures. Orbitals and Bonds, Amino Acids, Structural Organisation of Proteins, Nucleic acids, Principles of Base-pairing/ Base-stacking, Nucleic Acid Families, Protein – folding, Carbohydrates, Lipids of Membranes	50
Unit-2	**Introduction to Techniques:** Introduction to Techniques for Structure determination: Spectroscopies :Light Scattering,(Rayleigh Scattering), Diffusion, Sedimentation, Osmosis, Viscosity, Chromatography, Optical activity, Absorption spectroscopy, NMR, Microscopies, X-ray diffraction. Bioenergetics: Reversible and Irreversible Thermodynamic, Photo- and Chemo bioenergetics.	50

REFERENCES

1.	Essential of Biophysics, P. Narayanan, New Age International (P) Limited Publishers

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Syllabus for

B. Sc. (Hons) PROGRAM WITH PHYSICS

under

SEMESTER 4

CHOICE BASED CREDIT SYSTEM

To be Implemented from Academic Year 2020-21

	The Maharaja Sayajirao University of Baroda Faculty/College of <<**Faculty of Science**>>, Department of <<**Physics Department**>> <<Address>>, <<Contact details>>, <<e-mail ID>>	**ACADEMIC YEAR** **2020-2021**

<<B.Sc. (Hons.) CBCS>> : << B.Sc. (Hons.) CBCSPhysics>>

YEAR	II	**Principal:**	CREDIT	4
Semester	IV	**<<PHY1401PT>> : <<ELEMENTS OF MODERN PHYSICS>>**	HOURS	60

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	**<<>>** <<Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension. **Illustrative Problems**>>	15 hrs.
UNIT-II	**<<Title>>** <<Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle-application to virtual particles and range of an interaction. One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scatteringandtunnelling in one dimension-across a step potential & rectangular potential barrier. **Illustrative problems**>>	15 hrs.
UNIT-III	**<<>>** <<Concepts of X-rays, properties of X-rays, production of X-rays , hard X-rays, soft X-rays, merits and demerits of X-rays, Crystalline and Non-crystalline Solids, Ionic solids, Covalent Solids, Vander walls bond, metallic bonds, molecular solids, band theoryof solids, superconductivity, intrinsic and impurity semiconductors. **Illustrative problems**.>>	15 hrs.
UNIT-IV	**<<>>**	15 hrs.

	<<Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gammarayemission,energy-momentumconservation:electron-positronpaircreation by gamma photons in the vicinity of a nucleus. Size and structure of atomic nucleus, Nuclear radius,Non-existence of electron in nucleus, NZ graph, Liquid Drop model: binding energy, B/A vs A curve interpretation, semi-empirical mass formula and binding energy, Limitation of liquid drop model and magic numbers, Nature of nuclear force. Fission and fusion reactions, Nuclear reactor, 4 factor formula, Energy production in stars. **Illustrative problems**>>	

REFERENCES

1.	Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2.	Modern Physics, Kenneth S. Krane, 2nd edition, John Wiley and Sons, Inc.
3.	Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
4.	Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
5.	PhysicsforscientistsandEngineerswithModernPhysics,JewettandSerway,2010, Cengage Learning.
6.	Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan

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	The Maharaja Sayajirao University of Baroda Faculty/College of <<**Faculty of Science**>>, Department of <<**Physics Department**>> <<Address>>, <<Contact details>>, <<e-mail ID>>	**ACADEMIC YEAR** **2020-2021**

<<B.Sc. (Hons.) CBCS>> : << B.Sc. (Hons.) CBCSPhysics>>

YEAR	II	**Principal:**	CREDIT	4
Semester	IV	**<<PHY1402PT>> : <<STATISTICAL MECHANICS>>**	HOURS	60

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	**<<Classical Statistics>>** <<Macrostate& Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof)– Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature.>>	15 hrs.
UNIT-II	**<<Title>>** <<**Classical Theory of Radiation:** Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Saha's Ionization Formula. Rayleigh-Jean's Law.	15 hrs.

	Ultraviolet Catastrophe. **Quantum Theory of Radiation:** Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: >>	
UNIT-III	**<<>>** <<**Quantum Theory of Radiation:** Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law. **Bose-Einstein Statistics:** B-E distribution law, Thermodynamic functions ofa strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas. Bose derivation of Planck's law.>>	15 hrs.
UNIT-IV	**<<Fermi-Dirac Statistics>>** << Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat ofMetals, Relativistic Fermi gas, White DwarfStars, Chandrasekhar Mass Limit.>>	15 hrs.

REFERENCES

1.	StatisticalMechanics,R.K.Pathria,ButterworthHeinemann:2nd Ed.,1996, Oxford University Press.
2.	Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
3.	Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
4.	Thermodynamics, KineticTheory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5.	Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
6.	An Introductionto Statistical Mechanics &Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

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	The Maharaja Sayajirao University of Baroda Faculty/College of <<**Faculty of Science**>>, Department of <<**Physics Department**>> <<Address>>, <<Contact details>>, <<e-mail ID>>	**ACADEMIC YEAR** **2020-2021**

<<B.Sc. (Hons) CBCS>> : << B.Sc. (Hons) CBCSPhysics>>

YEAR	II	**Principal:**	CREDIT	4
Semester	IV	**<<PHY1403PL>> : <<PHYSICS PRACTICALS-IV>>**	HOURS	120

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	**<<>>** <<Content/Chapters>>	60 hrs.

REFERENCES

1.	Stephen's Law of radiation
2.	Error Analysis
3.	To determine the Plank's constant using LEDDs of at least 4 different colours
4	To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
5	Photoelectric effect
6	Figure of merit
7	Band gap of a semiconductor
8	Determination of e/m

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	The Maharaja Sayajirao University of Baroda Faculty/College of <<**Faculty of Science**>>, Department of <<**Physics Department**>> <<Address>>, <<Contact details>>, <<e-mail ID>>	**ACADEMIC YEAR** **2020-2021**

<<B.Sc. (Hons.) CBCS>> : << B.Sc. (Hons.) CBCSPhysics>>

YEAR	II	**GENERIC ELECTIVE:**	CREDIT	3
Semester	IV	**<<PHY1401ET>> : <<ELEMENTS OF MODERN PHYSICS>>**	HOURS	45

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	**<<>>** <<Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension. **Illustrative Problems**>>	15 hrs.
UNIT-II	**<<Title>>** <<Concepts of X-rays, properties of X-rays, production of X-rays , hard X-rays, soft X-rays, merits and demerits of X-rays, Crystalline and Non-crystalline Solids, Ionic solids, Covalent Solids, Vander walls bond, metallic bonds, molecular solids, band theoryof solids, superconductivity, intrinsic and impurity semiconductors. **Illustrative problems**.>>	15 hrs.
UNIT-III	**<<>>** <<Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gammarayemission,energy-momentumconservation:electron-positronpaircreation by gamma photons in the vicinity of a nucleus. Size and structure of atomic nucleus, Nuclear radius,Non-existence of electron in nucleus, NZ graph, Liquid Drop model: binding energy, B/A vs A curve interpretation, semi-empirical mass formula and binding energy, Limitation of liquid drop model and magic numbers, Nature of nuclear force. Fission and fusion reactions, Nuclear reactor, 4 factor formula, Energy production in stars. **Illustrative problems**>>	15 hrs.

REFERENCES

1.	Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2.	Modern Physics, Kenneth S. Krane, 2nd edition, John Wiley and Sons, Inc.
3.	Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill

4.	Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
5.	PhysicsforscientistsandEngineerswithModernPhysics,JewettandSerway,2010, Cengage Learning.
6.	Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004,Macmillan

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	The Maharaja Sayajirao University of Baroda Faculty/College of <<**Faculty of Science**>>, Department of <<**Physics Department**>> <<Address>>, <<Contact details>>, <<e-mail ID>>	**ACADEMIC YEAR** **2020-2021**

<<B.Sc. (Hons) CBCS>> : << B.Sc. (Hons) CBCSPhysics>>

YEAR	II	**GENERIC ELECTIVE :**	CREDIT	1
Semester	III	**<<PHY1402EL>> : <<PHYSICS PRACTICALS (EG)-III>>**	HOURS	30

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	**<<>>** <<Content/Chapters>>	30 hrs.

REFERENCES

1.	
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	The Maharaja Sayajirao University of Baroda Faculty/College of <<**Faculty of Science**>>, Department of <<**Physics Department**>> <<Address>>, <<Contact details>>, <<e-mail ID>>	**ACADEMIC YEAR** **2020-2021**

<<B.Sc. (Hons.) CBCS>> : << B.Sc. (Hons.) CBCSPhysics>>				
YEAR	II	**GENERIC ELECTIVE:**	CREDIT	3
Semester	IV	**<<PHY1403ET>> : <<STATISTICAL MECHANICS>>**	HOURS	45

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	**<<Classical Statistics>>** <<Macrostate& Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof)– Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature. **Illustrative problems**.>>	15 hrs.
UNIT-II	**<<Title>>** <<**Classical Theory of Radiation:** Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence, Stefan-Boltzmann law and thermodynamic proof, Radiation Pressure, Wien's Displacement law, Wien's Distribution Law, Rayleigh-Jean's Law, Ultraviolet Catastrophe. **Quantum Theory of Radiation:** Spectral Distribution of Black Body Radiation, Planck's Quantum Postulates, Planck's Law of Blackbody Radiation. **Illustrative problems**.>>	15 hrs.
UNIT-III	**<<>>** <<**Bose-Einstein Statistics:** B-E distribution law, Thermodynamic functions ofa strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), **Fermi-Dirac Statistics:** Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat ofMetals. **Illustrative problems**.>>	15 hrs.

REFERENCES

1.	StatisticalMechanics,R.K.Pathria,ButterworthHeinemann:2nd Ed.,1996, Oxford University Press.
2.	Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
3.	Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
4.	Thermodynamics, KineticTheory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5.	Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
6.	An Introductionto Statistical Mechanics &Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

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<<B.Sc. (Hons) CBCS>> : << B.Sc. (Hons) CBCSPhysics>>				
YEAR	II	**GENERIC ELECTIVE :**	CREDIT	1
Semester	III	**<<PHY1404EL>> : <<PHYSICS PRACTICALS (EG)-IV>>**	HOURS	30

OBJECTIVES:	

COURSE CONTENT / SYLLABUS		
UNIT-I	**<<>>**	30 hrs.
	<<Content/Chapters>>	

REFERENCES	
1.	
2.	
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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics	ACADEMIC YEAR 2020-2021

B.Sc. Physics Programme

Year	II	~~**Principal Group /Core/Elective**~~**/Foundation** **PHY1001FT : Nano Science**	Credit / Hrs per week	2
Semester	IV	Year of Introduction: 2018-2019		
Theory/~~Lab~~		Year of Syllabus Revision: 2020-2021	Max marks	50

Objectives	1. Learn basic concepts of **Nano science** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Employability/Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**Fundamentals of Nanoscience:** Definitions, Nano scopic Colours (Butterfly Wings), Bioluminescence (Fireflies), Tribiology (Geckos sticky feet, lotus leaf effect), Introduction to hydrophilic and hydrophobic materials, Nanotechnology timeline, Uniqueness of the nano scale, Future perspectives of nano science and nanotechnology, Inter conversion of units, Introduction to surface area to volume ratio and aspect ratio. Difference between surface area to volume ratio of bulk materials and nanomaterials (sphere, hollow, rods, hollow rods, cubes and hollow cubes) and related numerical problems. Mechanical, thermal, optical and magnetic properties	50
Unit-2	**Classification of Nanomaterials:** Nanomaterials and wavelength of light, Brief introduction to dimensional growth process and classification of nanomaterials into 0 D, 1 D, 2 D and 3 D. (Quantum dots, Quantum wires, Carbon nanotubes, Bucky balls, Fullerenes). Fundamentals of nanoscale self-assembly process involved in important functional biomoleculessuch as Nucleic acid (DNA and RNA), Proteins, Enzymes, Cell structure and organelles, nanoscale assembly of cellular components (cell membrane and liposomes), Nanoscale assembly of microorganisms (virus). Applications: electronic, biotechnology and Medical, Automobiles, Space, Defence, Sports, Cosmetics.	50

REFERENCES

1.	Nanotechnology: principles and Practices by Sulbha K Kulkarni, Capital Publishing Co. New Delhi
2.	Introduction to Nanoscience and Nanotechnology, KK Chattopadhya and A N Banerjee, PHI learning Pvt

	Ltd. 2012
3.	Introduction to Nanotechnology, C.P. Poole Jr. and F.J. Ownes, Wiley
4.	Essentials in Nanoscience and Nanotechnology, N Kumar and SunitaKumbhat, Wiley
5.	Nanostructures and Nanomaterials, G Cao and Y Wang, World Scientific
6.	Nanomaterials, B. Viswanathan, Narosa
7.	Introduction to nanoscience and nanotechnology, CRC Press, Tylor and Francis Group, Boca Raton, G. L. Hornyak, H. F. Tibbals, J. Dutta and J J. Moore.
8.	Introductory Nanoscience: Physical and Chemical Concepts, CRC Press, Tylor and Francis Group, Boca Raton, M. Kuno.

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	The Maharaja Sayajirao University of Baroda Faculty of Science , Department of Physics		ACADEMIC YEAR 2020-2021	
B.Sc. Physics Programme				
Year	II	~~**Principal Group /Core/Elective**~~**/Foundation** **PHY1002FT : Biophysics**	Credit / Hrs per week	2
Semester	IV	Year of Introduction: 2018-2019		
Theory/~~Lab~~		Year of Syllabus Revision: 2020-2021	Max marks	50

Objectives	1. Learn basic concepts of **Biophysics** for applications in the field. 2. Build fundamental base required for the programme
Employability/ Entrepreneurship / Skill Development Aspects	Employability/Skill development
Course Outcome	Ability to grasp and understand the basics to develop further

COURSE CONTENT / SYLLABUS

		Weightage (%)
Unit-1	**Concepts of Bio Physics:** Concepts of classical physics at Limitation, Quantum principles of Atomic structures. Orbitals and Bonds, Amino Acids, Structural Organisation of Proteins, Nucleic acids, Principles of Base-pairing/ Base-stacking, Nucleic Acid Families, Protein – folding, Carbohydrates, Lipids of Membranes	50
Unit-2	**Introduction to Techniques:** Introduction to Techniques for Structure determination: Spectroscopies :Light Scattering,(Rayleigh Scattering), Diffusion, Sedimentation, Osmosis, Viscosity, Chromatography, Optical activity, Absorption spectroscopy, NMR, Microscopies, X-ray diffraction. Bioenergetics: Reversible and Irreversible Thermodynamic, Photo- and Chemo bioenergetics.	50

REFERENCES

1.	Essential of Biophysics, P. Narayanan, New Age International (P) Limited Publishers

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Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.Sc. Semester-V

Programme Specific Outcome (PSO)

PSO1 To learn basics of various Physical phenomenon's based on classical or quantum concepts and its applications.
PSO2 Develop methodology to understand and solve various problems
PSO3 Learn mathematical methods and computational techniques used in physical sciences
PSO4 Learn about various physical terms and its applications
PSO5 Advanced understanding and application of fields related to Spectroscopic, relativity, electronics, Electromagnetic theory and computational methods

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**	**Academic Year**	**2021-22**
B.Sc. (Physics): Regular Programme			
Year	**III**	**Principal /~~Core~~ / ~~Elective~~ / ~~Foundation~~** **PHY1501C17 : CLASSICAL MECHANICS**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2021-22 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1517PL

CO1 Introduction to basic concepts of Classical Mechanics
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	Mechanics of a particle, mechanics of a system of a particles, constraints and their classification and related examples. Virtual work and virtual displacement, principle of virtual work, D'Alembert's principle and related examples. Concepts of generalized coordinates, configuration space, Langrage's equation for generalized coordinates, General expression for kinetic energy with examples, Remarks on Lagrangian. Cyclic or ignorable coordinates.	01	25	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE
2	**Central force:** Definition and properties of central force, two body central force problem, reduction to the equivalent one body problem, Motion in central force field, Motion in an inverse square law force filed, Equation and stability of orbits, geometry of orbits and orbital elements, Keplers' law of planetary motion, Construction of an orbit from given set of initial conditions, Keplars problem in velocity space.	01	25	2,3	CO2	PSO3			
3	**Rigid body dynamics:** Degrees of freedom of a free rigid body, (independent coordinates of a rigid body) kinetic energy of a rotating rigid body, angular momentum and kinetic of motion about a point, Angular momentum, Euler's theorem on the motion of a rigid body, Tensors, the inertia tensor and moment of inertia, Angular momentum in laboratory and centre of mass frames, Euler's equation of motion for rigid body, Euler's' angles, Symmetrical top, Solving rigid problems.	01	25	2, 3, 4	CO3	PSO4 PSO5			

4	**Fluid dynamics:** Elementary Fluid Dynamics: Importance of fluids: Fluids in the pure sciences, fluids in technology. Study of fluids: Kinematics of moving fluid for continuous matter, equation of continuity and irrotational flow, equations of motion of an ideal fluid, Euler's equation of motion, Flow phenomena-flow dimensionality, steady and unsteady flows, uniform &non-uniform flows, viscous & inviscid flows, incompressible & compressible flows, laminar and turbulent flows, rotational and irrotational flows.	01	25	2, 3,4	CO4	PSO4 PSO5			

Reference Books

1.	Classical Mechanics – N. C. Rana and P. S. Jog 1991, Tata McGraw-Hill Pub. Co. td, New Delhi.
2.	Classical Mechanics by Goldstein, Poole and Salko, Pearson Asia Ed. 3rd Ed. (2002)
3.	Classical Mechanics – Simon, 4th Edition, 1977, Addison-Wesley, NY
4.	Classical Mechanics – R. G. Takwale and P. S. Puranik, 1979, Tata McGraw-Hill, New Delhi
5.	Berkeley Physics Course – Vol. I (Mechanics), Kittle, Knight, Ruderman, Helmholtz, Mayer 2nd Edition, 1981, McGraw Hill International, (Asia Student edition).

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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**	**Academic Year**	**2021-22**
B.Sc. (Physics): Regular Programme			
Year	**III**	**Principal /~~Core / Elective / Foundation~~** **PHY1502C18 :** **ELECTROMAGNETISM**	**Credits / Hours per week**	**04**

Semester	I	Year of Introduction: 2020-21 Year of Syllabus Revision:	Maximum Marks / Grade	100
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1502C18

CO1 Introduction to basic concepts of Electromagnetism
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	**Energy in Electrostatics:** Introduction toElectrostatic Potential, Relation between the Field and the potential) Equipotential Surfaces, Electrostatic Energy, Electric Dipole, Dipole in Uniform Electric Field, Electric Dipole in a Non-uniform Electric Field, Mutual Potential Energy of Two Dipoles, Electric Double Layers, Electric Quadruple.	01	25	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE

2	**Electrostatics in Dielectrics:** Revision ofBoundary Conditions, Gaseous Non-Polar dielectrics, Gaseous Polar Dielectrics, Non-Polar Liquids. Boundary Value Problems in Electrostatics Fields: Poisson and Laplace Equations, Earnshaw's Theorem, Boundary Conditions and Uniqueness Theorem, Solution of Lap lace's Equation in Spherical Polar Coordinates, The multi-pole Expansion, Method of Electrostatic Images, Images in Dielectrics.	01	25	2,3	CO2	PSO3			
3	**Magnetostatics:** The laws of Magnetostatics, The Magnetic Potentials, Current Loops in External Fields-Magnetic Dipole, Magnetic Dipole in a Non-uniform Magnetic Field, Magnetic Vector Potential due to a small Current Loop, An Alternative Method for Finding the Vector Potential A and, hence, the Field B due to a Current Loop, magnetic Media, Magnetization, Magnetic Field Vector, Magnetic Susceptibility and Permeability, Boundary Conditions (Magnetic Field), Uniformly Magnetized Sphere in External Magnetic Field, A comparison of Static Electric and Magnetic Fields.	01	25	2, 3, 4	CO3	PSO4 PSO5			

4	**Electromagnetic Induction& Maxwell:** **Electromagnetic Induction:** Electromotive Force, Faraday's law of Electromagnetic Induction, Induction law for Moving Circuits, Integral and Differential Form of Faraday's law, Self-Inductance and Mutual Inductance, Energy in Magnetic Fields, Hysteresis, Maxwell's Equations. **Maxwell Equations:** ReviewofMaxwell'sequations.DisplacementCurrent. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media. Plane Waves in a Conducting Medium, The Skin Effect, Poynting Theorem and Poynting Vector.	01	25	2, 3,4	CO4	PSO4 PSO5			

Reference Books

1.	Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2.	Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3.	Electricity and Magnetism, D.C Tayal, 4th Edition, 2019
4.	Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5.	Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6.	Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
	Additional Books for Reference
1.	Electromagnetic Fields & Waves, P.Lorrain&D.Corson, 1970, W.H.Freeman& Co.
2.	Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
3.	Electromagnetic fieldtheory fundamentals, B. Guru andH. Hiziroglu, 2004, Cambridge University Press

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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**	**Academic Year**	**2021-22**

B.Sc. (Physics): Regular Programme

Year	**III**	**Principal /~~Core / Elective / Foundation~~** **PHY1503C19 : NUCLEAR AND PARTICLE PHYSICS**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2020 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1503C19

CO1 Introduction to basic concepts of Nuclear and Particle Physics
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics
CO5 Understand basics of Spectroscopy
CO6 Applications to Vibrational and rotational spectra of diatomic molecule

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	**General Properties of Nuclei**: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. **Radioactivity decay**:(a) Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) β-decay:energy kinematicsforβ-decay, positronemission, electroncapture, neutrinohypothesis.(c) Gamma decay: Gamma rays emission & kinematics, internal conversion.**Illustrative examples**	01	25	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE
2	**Interaction of Nuclear Radiation with matter**: Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.- Elastic and Inelastic scattering of Neutrons . **Nuclear Reactions:** TypesofReactions,ConservationLaws,kinematicsofreactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering). Fission reaction, distribution of fission fragments, **Illustrative examples**	01	25	2,3	CO2	PSO3			

3	**Detector for Nuclear Radiations:** Characterisation of Gasfilled detectors: ionization chamber, proportional Counter and GM Counter. **Scintillation Detectors** Scintillation, Scintillation materials and classification, NaI(T) detector, photo multiplier tube. **Photo-multiplier tube (PMT).**Particle Accelerators: requirements of accelerator in nuclear physics, Van-de Graaff generator, Cyclotron. **Nuclear Reactor**: fission reactor, fusion reactor, nuclear reaction for energy Production in stars. **Illustrative problems**	01	25	2, 3, 4	CO3	PSO4 PSO5			
4	**Particle physics** : Particle interactions; types ofparticles and itsfamilies. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, Leptons, hadrons, Elementary particle quantum numbers:baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons.**Illustrative problems**	01	25	2, 3,4	CO4	PSO4 PSO5			

Reference Books

1.	Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2.	Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3.	Introduction to High Energy Physics,D.H.Perkins,Cambridge Univ. Press
4.	Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
5.	Concepts of Modem Physics, A. Bieser. TATA Mc Graw Hill (Indian Edition)
6.	Nuclear Physics D.C. Tayal. Himalaya Publishing House.2019
7.	Nuclear Physics: Problem based approach by H.M. Agrawal.PHI Learning (Eastern Economy Edition)

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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**	**Academic Year**	**2021-22**

B.Sc. (Physics): Regular Programme

Year	**III**	**Principal /~~Core /~~ ~~Elective /~~ ~~Foundation~~** **ELECTIVE - Discipline Specific** **PHY1504E15 :** **MATHEMATICAL PHYSICS &QUANTUM MECHANICS**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2020-21 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1504E15

CO1 Introduction to basic concepts of Mathematical Physics &Quantum Mechanics
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	Orthogonal curvilinear coordinates, Grad, div and curl and V^2 in spherical and cylindrical systems, Resolution of Cartesian unit vectors into their spherical polar co-ordinates, conversion of d/dx, d/dy and d/dz into their corresponding form in spherical polar co-ordinates, Expression for angular momentum, **Lz** and $\mathbf{L}^2$ in spherical polar co-ordinates, elementary ideas on tensors.	01	25	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE
2	**Matrices and Differential equations:** Definitions and types of matrices – rank of matrices – solution of linear algebraic equations (Cramer's rule) – test of consistency – eigenvalue equation and diagonalization Power series solution of 2nd order differential equations validity of the power series method, Power series solutions of Legendre's and Bessel's equation, recurrence relations, polynomials and generating functions of Legendre's, functions and generating functions of Bessel's equations, orthogonality of Legendre's and Bessel functions.	01	25	2,3	CO2	PSO3			

3	**Quantum Mechanics:** Linearity and superposition principle, and concept of Linear vector space. Operators in quantum mechanics: Energy and momentum operator, commutators of position and momentum operator, Uncertainty principle and calculation of expectation values of position and momentum operator (Ehrenfest theorem or corresponding principle). Eigen values and Eigen function for an operator. Hermitian operator and its properties. Basic postulates of quantum mechanics of N paraticle system. Related problems to the topics covered in this unit.	01	25	2, 3, 4	CO3	PSO4 PSO5			
4	Time dependent/independent Schrodinger wave equation(in 1D & 3D)Schrodinger equation and dynamical evolution of wave function, Physical interpretation of wave function and its properties and conditions for its physical acceptability. Normalization of the wave function. Probability and probability current density in three dimensions. General discussion of bound/unbound states in an arbitrary potential – continuity of wave function, boundary condition and emergence of discrete energy levels. (in one dimension) Related problems to the topics covered in this unit.	01	25	2, 3,4	CO4	PSO4 PSO5			

Reference Books

1. Mathematical Methods for Physicists, by G. Arfken and Weber.
2. Advanced Engineering Mathematics, by E. Kreyszig , Wiley Pub.

3.	Mathematics for Physicists, by Mary L. Boas
4.	Mathematical Physics, by B.D. Gupta
5.	Mathematical Physics, by H.K. Dass
6.	Mathematical Physics, by Gupta &Rajput, Pragati Publication, Meerut

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The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**		**Academic Year**	**2021-22**
B.Sc (Physics): Regular Programme			
Year	**III**	**Principal / ~~Core~~ / ~~Elective / Foundation~~** **PHY 1505PL: PHYSICS LABORATORY EXPERIMENTS-V**	**Credits / Hours per week**	**06**
Semester	**I**	Year of Introduction: 2021-22 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Laboratory Experiments, discussion and viva	**PSO7 is common for all experiments**	

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	QUARTER WAVE PLATE		**PHY1505C17**	1,2	CO1	PSO1
2	FABRY PEROT ETALON			2		PSO2
3	LLOYD`S MIRROR			2,3		PSO1, PSO2
4	HARTMAN`S FORMULA			3,4		PSO4
5	GONIOMETER			2,3	CO1	PSO1, PSO4
6	APPLICATION OF C. R. O.			2,3		PSO1
7	BRIDGE RECTIFIER (FOR MUTUAL INDUCTANCE)			3,4		PSO2
8	THERMISTOR			2		PSO4
9	PHOTOCELL			2		PSO4
10	ANCHOR RING			2,3		PSO2, PSO4
11	MUTAUAL INDUCTANCE			2,3,4		PSO2, PSO4
12	SUSCEPTIBILITY OF A SOLUTION			2		PSO4

13	R. P. OF A PRISM			2,3,4	CO6	PSO1, PSO3
14	DOUBLE SLIT SOURCE METHOD			2,3		PSO1,
15	R. C. COUPLED AMPLIFIER(TRANSISTORISED)			2,3,4		PSO2
16	SERIES AND PARALLEL RESONANCE					
17	STAFAN`S CONSTANT					
18	FILTER CIRCUITS : RIPPLE FACTOR AND VOLTAGE REGULATION					
19	Logic Gates					

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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**		**Academic Year**	**2021-22**
B.Sc. (Physics): Regular Programme				
Year	**III**	**Principal /~~Core /~~ ~~Elective /~~ ~~Foundation~~** **FOUNDATION - Skill Development** **PHY1506F02: NUMERICAL ANALYSIS**	**Credits / Hours per week**	**02**
Semester	**I**	Year of Introduction: 2020-21 Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1507F02

CO1 Introduction to basic concepts of Numerical Analysis
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	**Linear Equations:** Solution of system of linear Equations (direct methods, Iterative methods, Ill-conditioned systems)Roots of Nonlinear Equations (Bisection method, Newton-Raphson method, Fixed point iteration method, convergence criteriaEigenvalues and Eigenvectors, Jacobi method, Power method. Root finding methods used for physics based applications. Eigenvalue solution for physics based applications. Related Physics Problems.	01	50	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE

2	**Differential and Integration:** Interpolation (Bessel and Stirling's interpolation formulae, Lagrange interpolation and Newton's divided difference interpolation)Numerical Differentiation (central difference formula), Integration (Trapezoidal and Simpson's rules), Solution of first order and second order ordinary differential equations (Euler modified method, Runge-Kutta methods). Numerical integration methods used for physics based applications. Applications of solution of differential equations for problems in physics.	01	50	2,3	CO2	PSO3			

Reference Books

1.	Gerald, C. F. and Wheatly, P. O.," Applied Numerical Analysis", 6th Edition, Wesley.
2.	Jain, M. K., Iyengar, S. R. K. and Jain, R. K., "Numerical Methods for Scientific and Engineering Computation", New Age Pvt. Pub, New Delhi.
3.	Conte, S. D. and De Boor, C., "Elementary Numerical Analysis", Mc Graw Hill Publisher.
4.	Krishnamurthy, E. V. & Sen, S. K., "Applied Numerical Analysis", East West Publication.
5.	Introductory methods of Numerical Analysis by S.S. Sastry, 4th Edition, 2005, Prentice Hall Pvt. Ltd., New Delhi.
6.	Numerical Methods for mathematics; science and engineering by J. H. Mathews 2nd Edition 2007, Prentice Hall Pvt. Ltd., New Delhi.
7.	Numerical Analysis by Fleris & Burden

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Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: B.Sc. Semester-VI

Programme Specific Outcome (PSO)

PSO1 To learn basics of classical, quantum mechanics and its applications.
PSO2 Develop methodology to understand and solve various problems
PSO3 Learn mathematical methods and computational techniques used in physical sciences
PSO4 Learn about various physical terms and its applications
PSO5 Advanced understanding and application of fields related to either Spectroscopic, relativity, electronics, Electromagnetic theory and computational methods

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**	**Academic Year (to be implemented from)**	**2021-22**
B.Sc. (Physics): Regular Programme			
Year	**III**	**Principal /~~Core /~~ ~~Elective /~~ ~~Foundation~~** **PHY1601C23 : QUANTUM MECHANICS AND APPLICATIONS**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2020-21 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1601C23

CO1 Introduction to basic concepts of Quantum Mechanics and Applications
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics
CO5 Understand basics of Spectroscopy
CO6 Applications to Vibrational and rotational spectra of diatomic molecule

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	**Schrodinger Equation:** Application to one dimensional problems: Free particle, Particle in abox, square well potential problems (finite and infinite), Harmonic oscillator, calculation of its energy eigen values and interpretation of wave function. Particle in a non-rigid box. Alpha decay problem and related problems to the topics covered in this unit.	01	25	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE
2	**Quantum theory of hydrogen atom:** Quantum theory of H_2 atom: Time independent Schrodinger wave equation in spherical polar coordinates; separation of variables for second order partial differential equation and its solution; angular momentum operator and physical interpretation of quantum numbers; calculation of zero point energy; Radial wave functions ; calculation of the probability densities ; Problems related to the topics covered in this unit.	01	25	2,3	CO2	PSO3			

3	**Atomic Spectra:** Orbital angular momentum; orbital magnetic dipole moment; Larmor precession; Space quantization; Stern-Gerlach Experiment; vector atomModel; spin–orbit interaction; Fine structure of spectral lines; L-S and j-j couplings schemes; interactionenergy in L-S coupling; Pauli's Exclusion Principle; symmetric & anti-symmetric Wave Functions; spectroscopic notations; Spectra of alkali atom (Na); spectra of He atom, **Atoms in External Magnetic Field:** Normal and Anomalous ZeemanEffect Paschen Back and Stark Effect (Qualitative Discussion only).	01	25	2, 3, 4	CO3	PSO4 PSO5			
4	**Molecular Spectra:** Molecular formation; ionic bonding; covalent bonding; electron sharing; theories of bonding- the valence-bond and molecular orbital approaches; the H2+ molecular ion; the H_2 molecule; rotational energy levels of diatomic molecules; rotational spectra of diatomic molecules; vibrational energy levels of diatomic molecules; vibrational spectra of diatomic molecules; vibration-rotation spectra; electronic spectra; **Raman spectra**: Nature of Raman effect; experimental arrangement for Raman effect; molecular polarizability, quantum theory of Raman effect	01	25	2, 3,4	CO4	PSO4 PSO5			
Reference Books									

1.	ATextbookofQuantumMechanics,P.M.MathewsandK.Venkatesan,2nd Ed.,2010, McGraw Hill
2.	Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3.	Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
4.	Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
5.	Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
6.	Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
7.	QuantumMechanicsforScientists&Engineers,D.A.B.Miller,2008,CambridgeUniversity Press
8.	Atomic and Molecular Spectra: Laser, Raj Kumar, 5th Edn. 2017, Kedar Nath Ram Nath
	Additional Books for Reference
1.	Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
2.	Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
3.	Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer

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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**		**Academic Year (to be implemented from)**	**2021-22**
B.Sc. (Physics): Regular Programme				
Year	**III**	**Principal /~~Core~~ / ~~Elective~~ / ~~Foundation~~** **PHY1602C24 : SOLID STATE PHYSICS**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2020-21 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1604C24

CO1 Introduction to basic concepts of Solid State Physics
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics
CO5 Understand basics of Spectroscopy
CO6 Applications to Vibrational and rotational spectra of diatomic molecule

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	**The Crystalline State:** Basics of Crystal Structures, Unit Cell- Primitive Cell Structures, Symmetry Operations, Crystal Types, Indices of a Lattice Direction and a Lattice Plane, Introduction to Crystal Point Groups and Space groups, **Reciprocal Lattice and Determination of Crystal Structure:** Reciprocal Lattice, Bragg Law, Laue's Interpretation of X-ray Diffraction by Crystals, Construction of Reciprocal Lattice, Relationships between **a, b, c** and **a*,b*,c*,** Determination of Lattice Constants.	01	25	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE

2	**Ferroelectricity and Magnetism: Ferroelectric Properties of Materials:** Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectriceffect, Electrostrictive effect, Curie-Weiss Law, Ferroelectric domains, PE hysteresis loop. **Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.	01	25	2,3	CO2	PSO3			
3	**Band Theory and Lattice Dynamics: Elementary band theory:** Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of emiconductor, mobility, Hall Effect. Measurement of conductivity (four probe method) & Hall coefficient. **Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law.	01	25	2, 3, 4	CO3	PSO4 PSO5			

4	**Dielectric& Superconductivity:** **Dielectric Properties of Materials:** Polarization. Local Electric field at an Atom. DepolarizationField. ElectricSusceptibility. Polarizability Clausius Mosotti Equation. ClassicalTheoryofElectricPolarizability. NormalandAnomalousDispersion.relations. Langevin-Debyeequation.ComplexDielectricConstant. **Superconductivity:** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation)	01	25	2, 3,4	CO4	PSO4 PSO5			

Reference Books

1.	IntroductiontoSolidStatePhysics,CharlesKittel,8th Edition,2004,Wiley India Pvt. Ltd.
2.	ElementsofSolidStatePhysics,J.P.Srivastava,2nd Edition,2006,Prentice-Hallof India
3.	Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill.
4.	Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning.
5.	Solid-state Physics, H. Ibach and H. Luth, 2009, Springer.
6.	Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India.
7.	Solid State Physics, M.A. Wahab, 2011, Narosa Publications.

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B.Sc. (Physics): Regular Programme				
Year	**III**	**Principal /~~Core /~~ ~~Elective /~~ ~~Foundation~~** **PHY1603C25: SPECIAL THEORY OF RELATIVITY**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1603C25

CO1 Introduction to basic concepts of **Special Theory of Relativity**
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics
CO5 Understand basics of Spectroscopy
CO6 Applications to Vibrational and rotational spectra of diatomic molecule

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	Inertial and accelerated frames of reference, the earth as a reference frame, fixed stars and inertial reference frame, forces in inertial reference system, absolute and relative acceleration, fictitious forces, accelerometer, centrifugal (also pseudo force : Coriolis force) and centripetal forces, acceleration in uniformly rotating frame, Foucault pendulum, mechanics of N-particle system..	01	25	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE
2	Doppler Effect, Space-time diagram, world-line, the Twin Paradox, relativity in electromagnetism, variation of mass with velocity. relativistic formula for kinetic energy, Experimental verification of Time dilation, Lorentz transformation, Minkowski space, time like and space like intervals.	01	25	2,3	CO2	PSO3			
3	Four vectors, four velocity, four momentum, four force, General Introduction to Tensor, invariant, covariant and contravariant tensors and their products, Einstein's summation convention, problems invariance of electric charge, addition of velocities, problems in relativistic dynamics, Acceleration of a charged particle by constant longitudinal and transverse electric fields.	01	25	2, 3, 4	CO3	PSO4 PSO5			

4	Charged particle in a magnetic field, Covariant formulation of motion of a charge particle in the electromagnetic field (Lagrangian method) Relativistic elastic scattering, Centre of mass system and threshold energy, examples from photo production of pion and antiproton, General Theory of Relativity (Elementary).	01	25	2, 3,4	CO4	PSO4 PSO5			

Reference Books

1.	Concepts of Modern Physics – Arthur Beiser, 6th Edition, 2005, Tata McGraw-Hill, New Delhi.
2.	The special theory of Relativity : S. Banerji and A. Banerji, 2002, Prentice Hall Pvt. Ltd., New Delhi
3.	Berkeley Physics Course – Vol. I (Mechanics), Kittle, Knight, Ruderman, Helmholtz, Mayer 2nd Edition, 1981, McGraw Hill International (Asia Student edition).
4.	Feynman Lecture Series (Vols. I and II) Feynman, Leighton and Sands MIT reading, Addission Wesley 1964, (Narosa pub. India 1995).
5.	Introduction to Special Relativity R. Resnick (1989) Wiley Eastern Ltd., New Delhi.
6.	Classical Mechanics by Goldestein, Poole and Safko, Pearson education Asia, 2002
7.	Analytical Mechanics by L. H. Hand amd J. D. Finch Cambridge University press, reprint 2001
8.	Introduction to Special Relativity – By Gupta (2015)Pragati Prakashan, Meerut

	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**	**Academic Year (to be implemented from)**	**2021-22**

B.Sc. (Physics): Regular Programme

Year	**III**	**Principal /~~Core /~~ ~~Elective /~~ ~~Foundation~~** **ELECTIVE – DISCIPLINE SPECIFIC** **PHY 1604SDS01: ELECTRONICS AND APPLICATIONS**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2020-21 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1604EDS01

CO1 Introduction to basic concepts of **Electronics and Applications**
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics
CO5 Understand basics of Spectroscopy
CO6 Applications to Vibrational and rotational spectra of diatomic molecule

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	**Amplifier and Feedback:** Transistor Amplifier circuit design in CE, its load line analysis, voltage and Current gains, Analysis of a Common emitter Transistor amplifier in low, mid and high frequency range. Amplifier: Principles of feedback Negative. Feedback:- Effect of negative feedback on Band width, voltage shunt and voltage series feedback, current shunt and current series feedback, Emitter Follower and circuit analysis, Darlington amplifier its current and voltage gain, input and output impedance.	01	25	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE
2	**Oscillators and Wave shaping:** Transistor Oscillators: Principle of feedback in oscillators, Tuned Collector oscillator and its operation and circuit analysis, Tuned emitter oscillator and its operation and circuit analysis and Blocking oscillator. **Multivibrators:** Switching characteristics and switching times of a transistor, Astable-multivibrator: Circuit conditions and frequency of oscillator Schmitt trigger, Clamping circuits:- Positive & Negative peak clamping, zero level clamping, Clipping circuits:- Diode clipper (negative, positive peak), double ended zener diode and p-n junction diode clipping.	01	25	2,3	CO2	PSO3			

3	Operational Amplifier & Number Systems: Operational Amplifier: Characteristics:- Concept of Differential mode, Input off set voltage, Common mode rejection ratio, Bias Current, Input off set current, slew rate, input-output impedance, negative feedback in Op-Amp, Inverting, non-inverting, Summing, voltage follower, zero level detector & Comparator circuit analysis. **Number Systems:**- Binary number System its Conversion to decimal hexadecimal and octal system and vice versa, BCD code, Excess-3code, Gray code. Digital gates, Buffers and other gate formation by universal gates, Boolean algebraic laws and De-Morganization, Simplification of Boolean algebraic expressions, Parity generator and parity checker.	01	25	2, 3, 4	CO3	PSO4 PSO5			

4	**Measuring Instruments and Chip Technology:** **Introduction to CRO:** Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. **Integrated Circuits** (Qualitative treatment only): Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs. **Embedded system introduction:** Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges and design issues in embedded systems, elemental description of embedded processors and microcontrollers.	01	25	2, 3,4	CO4	PSO4 PSO5			

Reference Books

1.	Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2.	Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3.	Solid State Electronic Devices, B.G.Streetman&S.K.Banerjee, 6thEdn,2009, PHI Learning.
4.	Electronic Devices & circuits, S.Salivahanan&N.S.Kumar, 3rdEd. 2012, Tata Mc-Graw Hill.
5.	OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th Edition, 2000, Prentice Hall.
6.	Objective Electronics S.L Kakani and K.C. Bhandari, Himalaya Publishing House

7.	Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.
8.	EmbeddedSystems:Architecture,Programming&Design,R.Kamal,2008,Tata McGraw Hill.
9.	Embedded Systems: Design & applications, S.F. Barrett, 2008, Pearson Education.

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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**		**Academic Year (to be implemented from)**	**2021-22**
B.Sc. (Physics): Regular Programme				
Year	**III**	**Principal /~~Core /~~ ~~Elective /~~ ~~Foundation~~** **ELECTIVE – DISCIPLINE SPECIFIC:** **PHY1604EDS02:** **ASTRO PHYSICS & PLASMA PHYSICS**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1604EDS02

CO1 Introduction to basic concepts of Astrophysics & Plasma Physics
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics
CO5 Understand basics of Spectroscopy
CO6 Applications to Vibrational and rotational spectra of diatomic molecule

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	**Astronomical Scales & Solar activity:** Astronomical Scales: Astronomical Distance, Mass and Time, Scales, Brightness, Radiant Flux and Luminosity, Measurement of Astronomical Quantities Astronomical Distances, Stellar Radii, Masses of Stars, Stellar Temperature. The sun (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics. Helioseismology). Stellar spectra and classification Structure(Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification).	01	25	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE

2	**Star Formation:** Star formation: Evolution of Stars (Evolution on the Main Sequence, Evolution beyond the Main Sequence), Supernovae. Compact stars: Basic Familiarity with Compact Stars, Theory of White Dwarf, Chandrasekhar Limit, Neutron Star (Gravitational Red-shift of Neutron Star, Detection of Neutron Star: Pulsars), Black Hole. The Milky Way: Basic Structure and Properties of the Milky Way, Galaxy Morphology, Hubble's Classification of Galaxies, Elliptical Galaxies. Spiral and Lenticular Galaxies.	01	25	2,3	CO2	PSO3			
3	**Fundamentals of Plasma:** << Introduction to plasma physics: Occurrence of plasma in nature. Definition of plasma. Meaning of quasi neutrality and collective behaviour in plasma physics. Composition and characteristics of plasma. Concept of temperature in plasma physics. Debye shielding. Diffusion equation. The plasma parameter. Criteria of plasmas. Methods of producing plasma in laboratory. Surface phenomena, transport (or transfer) phenomena. Diffusion and mobility.	01	25	2, 3, 4	CO3	PSO4 PSO5			

4	**Motion of Charged Particles:** Motion of charged particles (single particle motions) in magnetic and electric fields. Uniform E and B fields. Non uniform E and B fields. Different types of drifts and its summary. Magnetic field varying in space and time. Adiabatic invariance of magnetic moment. Applications of plasma physics.	01	25	2, 3,4	CO4	PSO4 PSO5			

Reference Books

1.	K.S.Krishnasamy,'Astro Physics a modern perspective,'Reprint, NewAge International (p) Ltd, New Delhi, 2002.
2.	Baidyanath Basu,'Anintroduction to Astrophysics',Secondprinting,Prentice- Hall of India Private limited, New Delhi, 2001.
3.	Text book of Astronomy and Astrophysics with elements o fcosmology,V.B. Bhatia, Narosa Publication.
4.	Chandra Shekhar and his limit –Vignetts in Physics – By G Venkataraman – University Press India Pvt Ltd. 1992
5.	Stars, The Physics of Compact Objects, Wiley Inter Science
6	Srinivasan, G. 2011. Can Stars Find Peace? Universities Press (India) Pvt Ltd.
7	Srinivasan, G. 2014. Life and Death of the stars, Universities Press and Springer
8	Elements of plasma physics by S N Goswami
9	Introduction to plasma physics and controlled fusion (Vol. 1), F. F. Chen
10	Introduction to Plasma Physics, R. J. Goldston and P. H. Rutherford
11	Fundamentals of Plasma Physics, J. A. Bittencourt
12	Compact plasma and focused ion beams, Sudeep Bhattacharjee

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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**	**Academic Year (for implementation)**	**2021-22**

B.Sc (Physics): Regular Programme

Year	**III**	**Principal / ~~Core~~ / ~~Elective / Foundation~~** **PHY1605PL: PHYSICS LABORATORY EXPERIMENTS-VI**	**Credits / Hours per week**	**06**
Semester	**II**	Year of Introduction: 2020-21 Year of Syllabus Revision:	**Maximum Marks / Grade**	**100**
Mode of Transaction		Laboratory Experiments, discussion and viva		

No.	**Experiment**		**Course Code**	**BT Level**	**CO**	**PSO**
1	BABINET COMPENSTOR		**PHY1605PL**	1,2	CO1	PSO1
2	TEMPERATURE OF A FLAME			2		PSO2
3	R. P. OF GRATING			2,3		PSO1, PSO2
4	G. M. COUNTER			3,4		PSO4
5	CAPICITY OF A CONDENSER			2,3	CO1	PSO1, PSO4
6	SELF INDUCTANCE (RAYLEIGH'S METHOD)			2,3		PSO1
7	'h' BY PHOTOCELL			3,4		PSO2
8	HIGH RESISTANCE BY LEAKAGE			2		PSO4
9	POSITIVE FEED BACK			2		PSO4
10	MULTIVIBRATOR			2,3		PSO2, PSO4
11	OWEN`S BRIDGE			2,3,4		PSO2, PSO4
12	EDSER BUTLER FRINGES			2		PSO4
13	ABERATION METER			2,3,4	CO6	PSO1, PSO3
14	R. P. OF A TELESCOPE			2,3		PSO1, PSO6
15	'e/m' BY HELLICAL METHOD			2,3,4		PSO2
16	REGULATED POWER SUPPLY					
17	BAND GAP OF SEMICONDUCTOR					
18	PUSH-PULL AMPLIFIER STUDY					
19	STUDY OF DIFFERENT DIFFRACTION PATTERNS USING LASERS>>					

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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**	**Academic Year (to be implemented from)**	**2021-22**

B.Sc. (Physics): Regular Programme

Year	**III**	~~**Principal /Core /**~~ ~~**Elective /**~~ **Foundation (Skill development)** **PHY1606F03 :** **RENEWABLE ENERGY AND ENERGY HARVESTING**	**Credits / Hours per week**	**02**
Semester	**II**	Year of Introduction: 2020-21 Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1606F03

CO1 Introduction to basic concepts of Renewable Energy and Energy Harvesting
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics
CO5 Understand basics of Spectroscopy
CO6 Applications to Vibrational and rotational spectra of diatomic molecule

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	**Fossil fuels and Alternate Sources of energy:** Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. **Solar energy**: Solar energy, its importance, storage ofsolar energy, solar pond, non-convective solarpond, applications of solar pondand solar energy, solar waterheater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV equivalent circuits, and sun tracking systems. **Energy harvesting**: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. **Hydro Energy**: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.>>	01	50	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE

2	**Energy Harvesting:** **Ocean Energy**: Ocean Energy Potential against Wind and Solar, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. **Geothermal Energy**: Geothermal Resources, Geothermal Technologies. **Piezoelectric Energy harvesting**: Introduction, Physics and characteristics of piezoelectric effect, materialsand mathematical description ofpiezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, **Electromagnetic Energy Harvesting**: Linear generators, physics mathematical models, Carbon captured technologies, cell, batteries, power consumption, Environmental issues and Renewable sources of energy, sustainability.	01	50	2,3	CO2	PSO3 PSO4 PSO5			

Reference Books	
1.	Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2.	Solar energy - M P Agarwal - S Chand and Co. Ltd.
3.	Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4.	Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
5.	J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
6.	http://en.wikipedia.org/wiki/Renewable_energy

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	The Maharaja Sayajirao University of Baroda **Faculty of Science** **Department of Physics**	**Academic Year (to be implemented from)**	**2021-22**

B.Sc. (Physics): Regular Programme

Year	**III**	~~**Principal /Core /**~~ ~~**Elective /**~~ **Foundation (Skill development)** **PHY1606F05:** **COMPUTATIONAL PHYSICS**	**Credits / Hours per week**	**02**
Semester	**II**	Year of Introduction: 2020-21 Year of Syllabus Revision:	**Maximum Marks / Grade**	**50**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) PHY1606F05

CO1 Introduction to basic concepts of Computational Physics
CO2 Learn about the physical interpretation of wave function and Schrodinger equation
CO3 Solving the Schrodinger equation for arbitrary potentials
CO4 Understand the Application of quantum mechanics

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional(R)/Global (G) developmental needs	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	**Derivations &Algorithms for Numerical Solutions of Differential Equations:** Initial Value Problems: Solution of 1st order and 2nd order ODE by RK4 and Predictor Corrector method. Schrodinger equation using Numerov method. Boundary Value Problems: 1. Solution of set of linear differential equations by finite difference method. 2. Solution of 2nd order Partial Differential equations (i) Laplace equation [Gauss elimination method] (ii) Poisson's equation [Iterative method] (iii) Heat Flow equation [Crank-Nicholson Method] (iv) Wave equation [Central difference method]	01	50	2,3	CO1	PSO1 PSO2	EMP, SD	G	PE

2	**Computer Programming:** **FORTRAN 90/Mathematica:** Programming syntax for the followings: 1. Data types, constants, variables, operators : Arithmetic, relational 2. Control statements : IF-ELSE, GOTO, Do Loops 3. Array : Initialization & applications 4. Function & subroutine 5. Programs for problems based on solution of the followings: (i) Zero of the function: Bisection, NR method (ii) Definite integration: Simpson 1/3 method (iii) 1st order Differential equation: RK 4 & Predictor Corrector method (iv) 2nd order Differential equation (SHM): RK4 method (v) Constants from given data set: Least square Approximation (vi) Kirchhoff's law equations for circuit: Iterative method Eigenvalue problem: Power method.	01	50	2,3	CO2	PSO3 PSO4 PSO5			

Reference Books

1.	Introductory methods of Numerical Analysis by S.S. Sastry, 4th Edition, 2005, Prentice Hall Pvt. Ltd., New Delhi.
2.	1. Numerical Methods for mathematics; science and engineering by J. H. Mathews 2nd Edition 2007, Prentice Hall Pvt. Ltd., New Delhi.
3.	Computer programming in FORTRAN – 90 & 95 by V. Rajaraman, 2004 Prentice Hall Pvt. Ltd., New Delhi.

4.	Handbook of Mathematica by Walfram Research Ltd
5.	Numerical analysis by Fleris & Burden
6.	Numerical Methods by E. Balaguruswami 2006, Tata McGraw-Hill, New Delhi.
7.	Computational Physics An Introduction by R C Verma New Age International Publishers
8.	An Introduction to Computational Physics by Tao Pang, Cambridge University Press, 1997

Semester I

PHY1101PT: MECHANICS

Theory: (Credit-03)

Unit-I (15 hours)

Vector algebra: Vector identities, Physical introduction and interpretation to 'gradient, divergence, curl, and Laplacian operator', Line integral, Surface integral, Volume integral, Vector integrations of vector fields, Gauss's divergence theorem, Stoke's theorem statement, Green's theorem statement.

Work and Energy: Review of Work and Kinetic Energy Theorem, Conservative and non-conservative forces, Potential Energy, Energy diagram, Stable and unstable equilibrium, Conservative potential energy, Force as gradient of potential energy, Non conservative system introduction, Work done by non-conservative forces, Law of conservation of Energy.

Unit-II (15 hours)

Collisions: Elastic and inelastic collisions between particles, Centre of Mass and Laboratory frames.

Rotational Dynamics: Angular momentum of a particle and system of particles, Torque, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia, Calculation of moment of inertia for rectangular, cylindrical and spherical bodies, Kinetic energy of rotation dynamics, Motion involving both translation and rotation.

Elasticity: Review of elastic constants, Hooke's law, Relation between Elastic constants, Bending of beam, Bending Moment, Cantilever.

Unit-III (15 hours)

Oscillations: SHM: Review of Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-averages. Damped oscillation, Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor.

Fundamentals of Dynamics: Reference frames. Inertial frames; Galilean transformations; Galilean invariance, Review of Newton's Laws of Motion, Dynamics of a system of particles, Centre of Mass. Principle of conservation of momentum, Impulse.

Non-Inertial Systems: Non-inertial frames and fictitious forces, Uniformly rotating frame, Laws of Physics in rotating coordinate systems, Centrifugal force, Coriolis force and its applications.

Reference Books:

- Mechanics by D. S. Mathur (S Chand & Co. Ltd., N Delhi, 2006)

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Semester I

PHY1102PT: THERMAL PHYSICS

Theory: (Credit-02)

Unit-I (15 hours)

Laws of Thermodynamics: Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between CP& CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Unit-II (15 hours)

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for ($C_P - C_V$), C_P/C_V, TdS equations.

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Reference Books:

- Heat and Thermodynamics by Brij lal and N Subramaniyam (S Chand & Co.Ltd, New Delhi)
- Heat and Thermodynamics by A. B. Gupta and H. P. Roy (New Central Book Agency Pvt. Ltd., Kolkata 1999)
- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears & G.L.Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Semester I

PHY1103PL: PHYSICS LAB-I (Credit-03)

PHYSICS LAB: MECHANICS

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
4. To determine g by Bar Pendulum.
5. To determine g by Kater's Pendulum.
6. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g

Reference Books:

- Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

PHYSICS LAB: THERMAL PHYSICS

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine Stefan's Constant.
3. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
4. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
6. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
7. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system

Reference Books:

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House. Electricity and magnetism, Berkley physics course, Vol. II, Mcgraw books company.
- Electricity and magnetism by D Chattopadhyay and P C Rakshit (New Central book agency, Kolkatta)

- Electromagnetism by B B Laud 2nd Edition, Wiley eastern limited
- Electricity and Magenetism with Electronics by K. K. Tiwari (S. Chand & Company Ltd. 2007)
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal, 1985, Vani Publication.

Semester II

PHY1201PT: ELECTRICITY AND MAGNETISM

Theory: (Credit-03)

Unit-I (15 hours)

Electric Field and Electric Potential: Conservative nature of Electrostatic Field, Electrostatic Potential, Laplace's and Poisson equations, The Uniqueness Theorem, Potential and Electric Field of a dipole, Force and Torque on a dipole. (6 Lectures)
Electrostatic energy of system of charges, Electrostatic energy of a charged sphere, Conductors in an electrostatic Field, Capacitance of an isolated conductor, Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

Dielectric Properties of Matter: Electric Field in matter, Polarization, Polarization Charges, Electrical Susceptibility and Dielectric Constant, Capacitor (parallel plate, spherical, cylindrical) filled with dielectric, Displacement vector D, Relations between E, P and D, Gauss' Law in dielectrics.

Unit-II (15 hours)

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field B, Bio-Savart's Law and its simple applications: straight wire and circular loop, Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid, Properties of B: curl and divergence, Vector Potential, Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements.

Magnetic Properties of Matter: Magnetic Susceptibility and permeability, Relation between B, H, M, Ferromagnetism, B-H curve and hysteresis.

Electromagnetic Induction: (Rev. of Faraday's Law, Lenz's Law, Self Inductance and Mutual Inductance), Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to Maxwell's Equations, Charge Conservation and Displacement current.

Unit-III (15 hours)

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits, Complex Reactance and Impedance, Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width, Parallel LCR Circuit.

Network theorems: Ideal Constant-voltage and Constant-current Sources, Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem, Applications to dc circuits.

Ballistic Galvanometer: Torque on a current Loop, Ballistic Galvanometer: Current and Charge Sensitivity, Electromagnetic damping, Logarithmic damping, CDR.

Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education..
- Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
  University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin
- Cummings. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

Semester II

PHY1202PT: WAVES AND OPTICS-I

Theory: (Credit-02)

Unit-I (15 hours)

Wave Motion: Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves, Wave Equation, Particle and Wave Velocities, Differential Equation, Pressure of a Longitudinal Wave, Energy Transport, Intensity of Wave, Water Waves: Ripple and Gravity Waves.

Velocity of Waves: Velocity of Transverse wave, Vibrations of Stretched Strings, Standing (Stationary) Waves in a String: Fixed and Free Ends, Melde's Experiment. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

Unit-II (15 hours)

Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). [Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.]

Superposition of Two Harmonic Waves: Graphical and Analytical method, Lissajous Figures (1:1 and 1:2) and their uses, Phase and Group Velocities, Changes with respect to Position and Time, Energy of Vibrating String, Transfer of Energy, Normal Modes of Stretched Strings, Plucked and Struck Strings, Longitudinal Standing Waves and Normal Modes, Open and Closed Pipes, Superposition of N Harmonic Waves.

Wave Optics: Electromagnetic nature of light, Definition and properties of wave front, Huygens Principle, Coherence; Comparison of Temporal and Spatial Coherence. Wave train, Coherence length and coherence time, band width, Relation between coherence length and band width, Condition for spatial coherence.

Reference Books:

- Textbook of Optics by N. Subramanyam, Brijlal and M. N. Avadhamulu (S. Chand and Co. Ltd., New Delhi, 2006).
- Vibrations, waves and acoustics by D. Chattopadhyay and P.C. Rakshit (New Central book agency Pvt. India)
- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

- Text book of Vibrations and waves (Revised edition) by S.P. Puri (Macmilan India Ltd. 2004).
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
- University Physics. FWSears, MWZemanskyandHDYoung13/e,1986.Addison-Wesley