Four Year B. Sc. (Hons.) Physics Programme under NEP2020

INDEX & COURSE OUTLINE (B.Sc. Physics)

Semester-III

Semester-IV

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Major Physics** **PHM2003C: Mathematical Physics**	CREDIT	4
Semester	III		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	<<>> Introduction to vectors in the plane and in space, Recapitulation of Vector Algebra. Idea of linear independence, completeness, basis and representation of vectors. Properties of vectors under rotations. Scalar product and its invariance under coordinate rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Orthogonal curvilinear coordinates, Grad, div and curl and V2 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 L2 in spherical polar co-ordinates, elementary ideas on tensors. Vector calculus & Applications: Vector integration, surface and volume integration, flux of a vector field, Gauss' divergence theorem, Green's and stock.	15 hrs.
UNIT-II	<<>> First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor with simple illustration. Taylor series of two variable functions, Maxima, minima, saddle point evaluation of two variable functions using Taylor series. Constrained Maximization using Lagrange Multipliers.	15 hrs.
UNIT-III	<<>> 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.	15 hrs.

	Matrix: Rank of the matrix, matrix multiplication and inner product, Direct product, Diagonal matrix, orthogonal matrix, Hermitian and Unitary matrix, Eigen value and Eigenvector.	
Section-II		
UNIT-IV	**List of Experiments:** 1. Logic gates: Boolean algebra 2. Viscosity of a Liquid -Poiseuille's Method 3. Optical lever 4. Diffraction of light by single and double slit 5. Bi-prism 6. Velocity of light and Brewster angle determination	30 hrs.

Reference Books

1.	Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley
2.	Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Ed., Elsevier
3.	Advanced Engineering Mathematics, by E. Kreyszig, Wiley Pub.
4.	Essential Mathematical Methods, K. F. Riley and M. P. Hobson, 2011, Cambridge Univ. Press
5.	Higher Engineering Mathematics, B. S. Grewal, Khanna Publisher
6.	Differential Equations, George F. Simmons, 2007, McGraw Hill
7.	Vector Analysis and an introduction to TENSOR ANALYSIS, S. Lipschutz, D. Spellman, M. R. Spiegel, Schaum's Outline Series, Tata Mc Graw Hill Education Private Limited, edition 2009
8.	Mathematical Physics, by B.D. Gupta
9.	Mathematical Physics, by H.K. Dass
10.	Mathematical Physics, by Gupta &Rajput, Pragati Publication, Meerut
11.	Matrix Methods: An Introduction, R. Bronson, 1991, Academic Press
12.	A Students Guide to Vectors and Tensors, D. Fleisch, 2012, Cambridge University Press

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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Major Physics** **PHM2013C: Modern Physics**	CREDIT	4
Semester	III		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to: 1. Introduction to basic concepts of Modern Physics 2. Learn about the basics of quantum mechanics 3. Introduction of Special theory of relativity 4. Introduction of Atomic Physics and X-rays.

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Radiation and its nature** **Classical Theory of Radiation:** Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law and its applications. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Rayleigh-Jean's Law. Ultraviolet Catastrophe. Numerical problems related to the topics. **Quantum Theory of Radiation:** Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody 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. Numerical problems related to the topics. Photoelectric effect, Compton effect, Pair-production.	15 hrs.
UNIT-II	. Davisson-Germer experiment. De Broglie wavelength and matter waves. Wave-particle duality. Wave description of particles by wave packets. Heisenberg uncertainty principle and its applications, Group and Phase velocities and relation between them. Double slit experiment. Standing de Brogile waves of electron in Bohr orbits, Diffraction by a single slit. Position of electron in a Bohr orbit. Concept of wave function, Principle of superposition, Time dependent and independent Schrodinger equation, Eigen value equation	15 hrs.
UNIT-III	**Atomic and Molecular Physics** Beyond the Bohr's Quantum Model: Sommerfeld theory of elliptical orbits, Hydrogen atom energy levels and spectra: emission and absorption spectra, Stern-Gerlach experiment, Atomic excitation, Frank-Hertz Experiment; X-rays: Method ofproduction, X-ray spectra: Continuous and characteristic X-rays, Moseley Law, Width of spectral line.Introduction of Zeeman effect, Stark effect and Paschen-Back effect. Classification of Molecular spectra; formation of H_2 molecule (qualitative).	15 hrs.

Section-II		
UNIT-IV	**List of Experiments:** 1. Measurement of Stefen's constant 2. Solenoid I –Variation of Magnetic field with current and distance 3. To measure an accessible (Horizontal and vertical) height using sextant 4. To measure inaccessible height by using sextant. 5. To study the Specific rotation of sugar solution by polarimeter. 6. Plank's constant using LED	30 hrs.

Reference Books	
1.	Concepts of Modern Physics, A. Beiser, 2002, McGraw-Hill
2.	Modern Physics, G. Aruldhas and P. Rajagopal, PHI
3.	Modern Physics, R. A. Serway, C. J. Moses and C. A. Moyer, 2012, Thomson Brooks Cole Cengage
4.	Schaum's Outline of Modern Physics, R. Gautreau and W. Savin, 2020, McGraw Hill LLC
5.	Modern Physics for Scientists and Engineers, S. T. Thornton Rex, 4th edition, 2013, Cengage Learning
6.	Introduction to Modern Physics, R. Meyer, Kennard, Coop, 2002, Tata McGraw Hill
7.	Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 201
8.	Learning Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill.Modern Physics, R. Murugeshan, S Chand & Co. Ltd
9	Schaum's Outline of Beginning Physics II | Waves, electromagnetism, Optics and Modern Physics, A.Halpern, E. Erlbach, McGraw Hill.
10	Quantum Physics, Berkeley Physics, Vol.4. E. H. Wichman, 1971, Tata McGraw-Hill Co.
11	Quantum Mechanics: Theory and Applications, A. Ghatak and S. Lokanathan, 2004, Macmillan Publishers India Limited.
12	Introduction to Quantum Mechanics, D. J. Griffith, 2005, Pearson Education.
13	Atomic Physics, Ghoshal, 2007, S. Chand Publishing House.
14	Atomic Physics, J. B. Rajam, 1980, Chand Publisher

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Major Physics** **PHM2023C: Analog Electronics**	CREDIT	4
Semester	III		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Circuits and Network** Discrete components, Active & Passive components, 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. Equivalent circuit parameters by applying Thevenin's theorem, Norton's theorem. Determination of current through the given branch and voltage across the given element of circuit by applying Superposition theorem. Determination of equivalent circuit parameter in a given circuit by applying Thevenin's and Norton's theorem. Determination of load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem. Test and response of the given circuit by applying reciprocity theorem.	15 hrs.
UNIT-II	**Semiconductor & Diodes** Free and valance electrons, conductor, insulator, semiconductor, definition & energy band diagram. Doping in semiconductors, 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. Application of Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Ripple Factor and Rectification Efficiency. Basic idea about inductor capacitor filter. L section & π section filters& its comparison. special purpose devices – Tunnel diode, LED, Photodiode solar cell. (Principle and structure of Light Emitting Diode, Photo Diode, Solar Cell) Zener diode characteristics, voltage regulation .	15 hrs.
UNIT-III	**Transistor and its applications** Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cut-off & Saturation regions. Current gains α and β. Relations between them. Analysis of dingle stage transistor amplifier using h-parameter, voltage gain, current gain, input and output impedance. Comparison of transistor configuration – Q point, Dc and AC load line. Biasing its need and	15 hrs.

	fixing. Self-biasing techniques for stabilization. Thermal runaway, thermal stability conditions. Transistor as amplifiers, Faithful amplification, classification based on configuration, power and frequency, Transistor CE amplifier with biasing. Two stage RC coupled amplifier its working, gain in dB and frequency response. Feed back definition and its type, advantage and disadvantage, application. Oscillator and its definition and classification. LC tank circuit and its criterion, RC phase shifted crystal oscillator and its working and applications.	
Section-II		
UNIT-IV	**List of Experiments:** 1. Measurement of Stefen's constant 2. Solenoid I –Variation of Magnetic field with current and distance 3. To measure an accessible (Horizontal and vertical) height using sextant 4. To measure inaccessible height by using sextant. 5. To study the Specific rotation of sugar solution by polarimeter. **6.** Plank's constant using LED	30 hrs.

Reference Books

1.	Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill
2.	Electronics: Fundamentals and Applications, D. Chattopadhyay, P.C. Rakshit, New Age Publication
3.	Electronic Devices & circuits by Allen Mottorshed
4.	Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
5.	A text book of electrical Technology (Vol.I) by B. L. Theraja & A.K. Theraja, S. Chand and Co. New Delhi 2006 ISDN:978-81-219-2550-5
6.	Fundamental of electrical engineering by Saxsena S. B. & Dasgupta K. , Cambridge University Press Pvt. Ltd., New Delhi 2016 ISBN: 978 1074 64353
7.	Circuit nd Network by Sudhakar A. & Pulli Shymmohan S. McGraw Hill, New Delhi, 2005. ISBN: 978-0-07-340458-5
8.	Electric circuit analysis Paranjothi S. R. New Publisher, New Delhi, 2011 ISBN: 978 0195425246

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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**MDC Physics** **MDC2563C: Physics for Biologists**	CREDIT	4
Semester	III		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	<<>> 1. Determination of structure of biomolecules: Algorithm 2. Type of crystal shape, basis vectors, Miller indices 3. Example of Miller indices 4. Evaluate the interplanar distance d_{hkl} 5. Electron density distribution within a molecule 6. Scattering factor, momentum transfer 7. Importance of phase 8. Determination of phase with derivative crystal 9. Reciprocal lattice 10. Bragg's law from reciprocal lattice 11. Determination of structure of Protein molecule: Schematic representation	15 hrs.
UNIT-II	<<>> 1. Bright and dark field microscopy 2. Phase contrast microscopy 3. Explanation of Rayleigh criteria for microscopy 4. Various spectroscopic methods applied to biomolecules and corresponding interactions. 5. Induce dipole moment by light scattering 6. Optical Rotatory dispersion 7. Drude equation, Circular dichroism 8. Characteristic CD Spectrum 9. Components of spectrophotometer 10. Chromophores with different bond energy levels 11. Spin calculation of nucleus 12. Introduction to NMR, its working principle	15 hrs.
UNIT-III	<<>> 1. Epifluorescence microscopy 2. Fluorophores, Quantum dots and fluorescent proteins, and their properties – extinction coefficient, quantum yield, brightness, fluorescence lifetime 3. Total internal reflection fluorescence microscopy	15 hrs.

	4. Laser scanning confocal microscopy 5. Quantitative fluorescence imaging – FRET, FCS, FLIM, FRAP 6. Electron microscopy – SEM, TEM and cryo-EM 7. Atomic Force microscope, Optical and Magnetic Tweezers	
Section-II		
UNIT-IV	**Experimental Biophysics:** 1. Analysis of NMR spectra of biomolecules 2. Analysis of XRD (single crystal / powder) of biomolecules 3. Study of diffusion of molecules in agar plates 4. Surface tension of liquids with the help of capillary 5. Light diffraction by tungsten filament and diffraction of X-rays by DNA double helix 6. Beer Lambert's Law 7. Magnification, numerical aperture and resolving power of an optical microscope 8. Atomic force microscopy applied to DNA elasticity 9. Image processing using Python and Image J 10. Topology, chirality, elasticity of biomolecules and cell mechanical properties.	30 hrs

Reference Books

1.	Biophysics – An Introduction by Rodney Cotterill
2.	Biophysics – Roland Glaser
3.	Biophysics – P. Narayan
4.	Handbook of Biological Confocal Microscopy, Edited by James B. Pawley, Springer.

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc.(Hons.) Programme under NEP2020-Physics

YEAR	II	**MDC** **MDC2573C: Applied Electronics devices and Applications**	CREDIT	4
Semester	III		HOURS	45 + 30

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	<<>> Semiconducting materials and devices, Effect of temperature on Extrinsic semiconductors, Mobility and Conductivity for Intrinsic/Extrinsic semiconductors, mass-Action Law, PN Junction Diode, Forward and Reverse characteristics, PN Diode ratings, Tunnel diode, UJT, Varactor diode, LED, Photodiode, Solar cell Transistor, IV characteristics of CE Transistor. Types of displays: CRT, LCD, LED, OLED.	15 hrs.
UNIT-II	<<>> Power Supply: Half-wave Rectifiers, Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, Basic idea about filters Inductive filter, LC filter (L type and π filter), Zener Diode and Voltage Regulation, Clipper, Clamper, Voltage multiplayer circuit, Digital Multimeter and application. Transducer definition, different types, criteria for selection Transducers for measurement of lamp, (Thermocouple & RTD) , Transducers for measurement of pressure, strain.	15 hrs.

Section-II

UNIT-III & IV	**List of Experiments:** 1. Measurement of Stefen's constant 2. Solenoid I –Variation of Magnetic field with current and distance 3. To measure an accessible (Horizontal and vertical) height using sextant 4. To measure inaccessible height by using sextant. 5. To study the Specific rotation of sugar solution by polarimeter. 6. Plank's constant using LED	30 hrs.

Reference Books

1.	Electronic Principles: Sanjay Sharma, S. K. Kataria& sons, 2009
2.	Basic Electronics: V K Mehta, S. Chand & Co. 2009
3.	Basic Electronics" by D P Kothari and I Nagrath
4.	Electronics for Physicists: An Introduction (Undergraduate Lecture Notes in Physics)
5.	Getting Started Electronics by Forrest M. Mims
6.	Digital Principles and applications by Donald P Leach, Albert Paul Malvino and Goutam Saha, TATA McGraw Hill Education Private Limited
7.	Semiconductor Physics and Devices by Donald Neamen

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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Skills Enhancement Courses (SEC)**	CREDIT	2
Semester	III	**SEC2463C: Computer Programming for Scientists**	HOURS	30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Introduction & Shell Programming** Introduction to Linux OS, basic commands for files and directories- cd, ls, cp, md, mkdir, rm, pwd. file creations, reading and writing the files. File edittor commands vi and gedit. awk, grep, head and tail commands with combination of pipe, mathematical and logical commands. **Shell Programming:** shell variables, reading writing commands, shell programming in bash, conditional and loop statements, creating shell programs for automate system tasks	15 hrs.
UNIT-II	**Python & Scilab** **Python:** Intoduction to python, variables, data types, reading and printing of files, mathematical operators, conditional statements, loop statements- while and for loop; scripting for scientific problems **Scilab**: Introduction to Scilab; Arrays; vectors and matrices; Array indexing; linear and logical indexing; plotting commands for line, polar, rose, contour and others shapes, histograms and images; Matrix operations, Example codes for scientific problems.	15 hrs.

Reference Books

1.	The Linux Command Line, 2nd Edition by William E. Shotts.
2.	Advanced Bash Scripting Guide by Mendel Cooper.
3.	Automate the Boring Stuff with Python by Al Sweigart
4.	Python Crash Course by Eric Matthes
5.	Introduction to Scilab by Michaël Baudin from the Scilab consortium.
6.	Programming in Scilab by Ranjan Goyal and Mansi Dhingra.

Online sources

1.	GNU Bash Reference Manual: https://www.gnu.org/software/bash/manual/
2.	Official Python Tutorial: https://docs.python.org/3/tutorial/
3.	Scilab Documentation: https://scilab.gitlab.io/legacy_wiki/Documentation

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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Indian Knowledge System (IKS)**	CREDIT	2
Semester	III	**IKS2363C: Indian Astronomy**	HOURS	30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

UNIT-I	<<>> System employed for representing numbers , Spherical trigonometry, Celestial Sphere, Pancanga, Planetary computations, Computation of the true longitudes of planets, Precession of equinoxes- Sayana and Nirayana longitude, Finding the cardinal directions and the latitude of a place, Determination of the variation of the duration of the day at a given location, Lagna and its computation, Eclipses and their computation, Development from the vedic period up to the Siddhantic Period, Solar and Lunar Eclipse, Triprasna Topics , Rates of motion of planets,	15 hrs.
UNIT-II	<<>> Rising times of Rasis and finding lagna, The Vakya System, Astronomical Instruments, Ancient records of the observation of the motion of celestial bodies like Sun, Moon Nakshatra and Graha. Elements of Indian calendar system, important text of Indian astronomy , basic idea of planetary model of Aryabhata and it's revision by Nilakantha Somayaji, Astronomical endeavour of Jaisingh, Sankravarman, Chandrasekhara Samanta, Indian Astronomy in the 18^{th} and 19^{th} centuries.	15 hrs.

Reference Books

1.	Astrophysics: stars and Galaxies by K. D. Abhyankar Universities press (India) Limited 2005
2.	Astronomy : Principles and practice by A. Roy and D. Clarke, IOP, 2003.
3.	Astrophysical techniques : C. R. Kitchin, Adam Hilger, 1991.
4.	Astrophysics –I and II R. Bower and T Deeming, Jones and Barlett, 1984.
5.	Astrophysics for physicists : Arnab Rai Choudhari, Cambridge University press, 2010
6.	The Modern Astrophysics, B. W. Carroll and D. A. Ostlie, Addison-Wesley Publishing Co.
7.	Physical Universe: An Introduction to Astronomy, F. Shu, Mill Valley : University Science Books

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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Indian Knowledge System (IKS)** **IKS2373C: -Indian Contribution to the Physics**	CREDIT	2
Semester	III		HOURS	30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

UNIT-I	<<>> Advanced in physical sciences through observations with light. Transit of Mercury (1651 AD) observed at Surat. Discovery of the binary nature of the bright star *Alpha Centauri* at Pondicherry (1698 AD). Accomplishments with Nadras observatory as meridian for Great Trigonometric Survey of India. Discovery of vaiable star *R Reticull* by Chintamani Ragiinathchaari. Historical outline of observatory at Trivendrum and the Lucknow Observatory . Discovery of spectral line due to Helium during Total Solar Eclipse at Guntur. The first heliscope at Simla. Spectroscopic Solar photography in Calcium K and Hydrogen *alpha* light	15 hrs.
UNIT-II	<<>> Transition of science to modern period. Brief summary of monumental contributions by J. C. Bose, S. N. Bose, Meghnad Saha, Sir C. V. Raman, H. J. Bhabha and N.S. Kapany about the nature of electromagnetic waves abd their interaction with matter. Raman Effect anf its modern applications. Discovery of Comet (C/1949N1-Bappu-Bok-Newkirk comet) by M. K. Vainu Bappu. Wilson-Bappu Effect about emission of Ca II K spectral lines. Contributions by N. N. Sen, V. V. Narlikar, P. C. Vaidya, A. K. Raychaudhari, S. Chandrasekhar and C. V. Vishveshwara and E.C.G. Sudarshan, V. A. Ssarabhai and Harish-Chandra in modern physics, P. C. Ray in Chemistry, S. Ramanujan in Mathematics P. C. Mahalnobis in Statistics, P. N. Bose and B. Sahni in geology and palaeobotany.	15 hrs.

Reference Books

1.	Indian National Science Academy Publication: “Aryabhatiya” original by Aryabhat and Hindi Translation by Ram Niwas Rai (INSA, New Delhi)
2.	Indian National Science Academy Publication: “Aryabhatiya” Aryabhat ‘s original text with English Translation by Kripa Shankar Shukla anf K. V. Sharma (INSA, New Delhi)
3.	Indian Journal of History of Science: Vol.18, 2. (on Aryabhat’s works).
4.	“Brahmasphut-siddhsnts”, (original with commentary): Pt. Sudhakar Dwivedi (Varanasi, 1902)
5.	“Siddhanta-Shiromani”: original by Bhaskar II: Commentary by Bapudev Shastri (Varanasi, 1913)
6.	GunakarMuley, “Bhaskaracharya” , Rajkamal Prakashan, 2011

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Semester-IV

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Major Physics** **PHM2004C: Quantum Mechanics-I**	CREDIT	4
Semester	IV		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to: 1. Introduction of basic concept of Quantum Mechanics and operators in Quantum Mechanics 2. Introduction of Schrodinger equations 3. Understand the Application of Schrodinger equations

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Mathematical tools for Quantum Mechanics** Linearity and superposition principle, and concept of Linear vector space, Hilbert space, Dirac Notation, Operators in quantum mechanics: Energy and momentum operator, commutators Algebra, 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. Related problems to the topics covered in this unit.	15 hrs.
UNIT-II	**Postulates of Quantum Mechanics** Basic postulates of quantum mechanics of N particle system.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.	15 hrs.
UNIT-III	**Application of Schrodinger Equation** Application to one dimensional problems:Free particle, The potential step, Particle in abox, Symmetric and asymmetric square well potential problems (finite and infinite), Quantum mechanical tunneling, Harmonic oscillator: Schrodinger method and Operator method, calculation of its energy eigen values and	15 hrs.

	interpretation of wave function. Alpha Emission, Related problems to the topics covered in this unit.	
Section-II		
UNIT-IV	**List of Experiments:** 1. Boltzmann constant using diode IV characteristics 2. Determination of Fermi Energy of Cu wire 3. Study of Solar cell characteristics 4. Band gap of semiconductor 5. Study of Photo cell	30 hrs

Reference Books

1.	Introduction to Quantum Mechanics, D. J. Griffith, 2005, Pearson Education.
2.	Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn., 2002, Wiley.
3.	Quantum Physics, Berkeley Physics, Vol.4. E. H. Wichman, 1971, Tata McGraw-Hill Co.
4.	Quantum Mechanics: Theory and Applications, A. Ghatak and S. Lokanathan, 2004, MacmillanPublishers India Limited.
5.	Quantum Mechanics: Concepts and Applications, N. Zettili, Wiley

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Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Major Physics** **PHM2014C: Classical Mechanics and Astrophysics**	CREDIT	4
Semester	IV		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Classical Mechanics** **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(equation of motion and first integrals), Motion in an inverse square law force filed(general features of the motion inclusive arbitrary field) , Equation and stability of orbits, geometry of orbits(inclusive condition for closed orbit) and orbital elements, Keplers' law of planetary motion, Construction of an orbit from given set of initial conditions (inclusive motion in time in Kepler problem), General relativistic corrections to central force, Scattering as a central force problem(classical Rutherford approach).	15 hrs.
UNIT-II	**Astronomy outline** Methods of Astronomy and Astrophysics. Geometry of the sphere: Different coordinate systems (Spherical coordinates, The altzimuth system, Universal equatorial system, aspects of the sky at glance) and location of celestial objects, Spherical geometry formulas. Night sky, Apparent Luminosities of stars : Magnitude scale (apparent and absolute) and simple problems related to both luminosity and magnitude. Astronomical Scales: Astronomical Distance, Mass and Time, Brief about measurement of Astronomical Quantities(mainly distance, flux, luminosity and spectra). Brief about different branches in astrophysics(both ground and space based). Nature of observables : Macroscopic bodies, Atomic particles, Electromagnetic radiation and photon. Different type of optical telescopes and it's general properties and its limitations.	15 hrs.
UNIT-III	**Basic astrophysical concepts** **(A)** Stars and stellar spectra: Nature of stellar spectra(Kirchoff's law and radiation in quasi-thermodynamics equilibrium). Spectral classification of stellar spectra : Spectral type, Henry-Draper classification, Final HD classification, Hertzsprung-Russell diagram, Basics of Stellar evolution ,	15 hrs.

	Stars in formation, Mass-radius relation and Binary stars, different types of binary stars and its parameters. End stage of stellar evolution and compact objects namely : White Dwarf, Chandrasekhar limit, Neutron stars, Supernovae(inclusive brief classification), Black holes. **(B)** Large scale objects in the Universe(Basics only) : Cosmological distance and galaxies, The Milky Way: Basic Structure and Properties of the Milky Way Different types of galaxies : Spiral, elliptical, irregular, Morphological classification and brief kinematics, Hubble's law, Ideas of local cluster and group of clusters.	
Section-II		
UNIT-IV	**List of Experiments:** 1. Calibration of spectrometer. 2. Measurement and identification of spectral lines (Hg and Na source) 3. Telescope activity 4. Determination of Young's modulus by Carnu's method 5. Resolving power of diffraction grating 6. Double refraction	30 hrs

Reference Books

1.	Classical Mechanics by Goldstein, Poole and Salko, Pearson Asia Ed. 3rd Ed. (2002)
2.	Classical Mechanics – R. G. Takwale and P. S. Puranik, 1979, Tata McGraw-Hill, New Delhi
3.	Classical Mechanics – N. C. Rana and P. S. Jog 1991, Tata McGraw-Hill Pub. Co. Ltd, New Delhi.
4.	Astrophysics: stars and Galaxies by K. D. Abhyankar Universities press (India) Limited 2005
5.	Astronomy : Principles and practice by A. Roy and D. Clarke, IOP, 2003.
6.	Astrophysical techniques : C. R. Kitchin, Adam Hilger, 1991.
7.	Astrophysics –I and II R. Bower and T Deeming, Jones and Barlett, 1984.
8.	Astrophysics for physicists : Arnab Rai Choudhari, Cambridge University press, 2010
9.	The Modern Astrophysics, B. W. Carroll and D. A. Ostlie, Addison-Wesley Publishing Co.
10.	Physical Universe: An Introduction to Astronomy, F. Shu, Mill Valley : University Science Books

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Major Physics** **PHM2024C: Properties of Matter, Low Temperature Physics & Vacuum**	CREDIT	4
Semester	IV		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**General Properties of Matter:** Mechanical properties of solids, Stress-strain relationship, Hooke's law, Elastic moduli. Mechanical properties of fluids, Pressure due to a fluid column, Pascal's law and its applications (hydraulic lift and hydraulic brakes). Viscosity, Stokes' law, Terminal velocity, Streamline and turbulent flow, Critical velocity, Bernoulli's theorem and its applications. Surface energy and surface tension, Angle of contact, Excess-pressure across a curved surface, Effects of surface tension to tension to drops, bubbles and capillary rise.	15 hrs.
UNIT-II	**Continuum Mechanics & Fluid Mechanics:** **Continuum Mechanics:** Elasticity Stress and Strain tensors, Hooke's law, Isotropic solids and their conditions for equilibrium, Energy of deformation, Propagation of waves in an elastic medium. **Fluid Mechanics**: The equation of continuity, Euler's equation for ideal fluids, Hydrostatics, Bernoulli's theorem, Potential flow, Incompressible fluids, Newtonian fluids, Navier - Stokes equation and its applications. Poiseuille's formula, Couette flow, Turbulent flow and Reynold's number, Brief introduction to astrophysical fluid dynamics.	15 hrs.
UNIT-III	**Low Temperature Physics and Vacuum Techniques:** Production of low temperature, thermodynamics of liquefaction, Joule-Thompson liquefier, cryogenic system design, cryostat design, heat transfer, temperature control, Adiabatic demagnetization. Cryogenic thermometry: gas and vapor pressure thermometers, resistance, semiconductor and diode capacitance thermometers, thermocouples, magnetic thermometry. Different types of pump: rotary pump, diffusion pump, ion pump, pumping speed, conductance and molecular flow; vacuum gauges; Macleod, Pirani and ionization gauges. Electrical measurements: A. C. meters, dynamometer type moving coil ammeter and voltmeter, moving iron and hot wire instruments, induction type instruments, wattmeters and energy meters.	15 hrs.

Section-II

UNIT-IV	**List of Experiments:** 1. Use of ballistic galvanometer in the measurements of (i) magnetic flux, (ii) self inductance, (iii) mutual inductance , (iv) high resistance by leakage. 2. Absolute determination of the ohm and the ampere, standard of resistance, voltage, inductance and capacitance, absolute and secondary measurements. 3. Generalized Wheatstone bridges for the measurement of R. I. and C common AC bridges. 4. Three phase systems, star and delta connections, rotating magnetic field, three phase and single phase induction motors.	30 hrs

Reference Books	
1.	CLASSICAL MECHANICS: RAN & JOG McGraw Hill NEW DELHI
2.	Daniel Kleppner and Robert Kolenkow, “An Introduction to Mechanics”(Mc Graw Hill),2017. 2e.
3.	Charles Kittel, Walter D. Knight, Malvin A. Ruderman, Carl A. Helmholz,Burton J. Moyer, “Mechanics (In SI Units): Berkeley Physics Course Vol 1”, McGraw Hill, 2017, 2e.
4.	Richard P. Feynman, Robert B. Leighton, Matthew Sands, “The Feynman Lectures on Physics - Vol. 1”, Pearson Education Limited, 2012.
5.	Halliday, Resnick and Walker, “Principles of Physics”, (Wiley) 2018, 10e.
6.	Frank S. Crawford, Jr, “Waves”: Berkeley Physics Course Vol 3”, McGraw Hill, 2017.
7.	D.S. Mathur, “Mechanics”, S. Chand Publishing, 1981, 3e.
8.	Handbook of Vacuum Technology, Editor(s): Karl Jousten, First published:9 June 2016, Print ISBN:9783527413386 |Online ISBN:9783527688265 |DOI:10.1002/9783527688265 Copyright © 2016 Wiley-VCH Verlag GmbH & Co. KGaA. All rights reserved.
9.	Handbook of Vacuum by A H Beck Pergamon (2013) (sold by Amazon – Asia pacific holfngs Pvt. Ltd.
10.	Vacuum science Technology and applications: Pramod K Naik Cambridge International (Published in India by Viva books)
11.	Vacuum Technology: Practice for Scientific Instruments [Special Indian Edition - Reprint Year: 2020] [Paperback] Nagamitsu Yoshimura
12.	Vacuum Science and Technology by T B GHOSH, K L CHOPRA, V V RAO, WOODSIDE Ny(USA)

Web References	
1.	MIT Open Learning - Massachusetts Institute of Technology, https://openlearning.mit.edu/
2.	National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
3.	Uttar Pradesh Higher Education Digital library http://heecontent.upsdc.gov.in/SearchContent.aspx
4.	Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Minor Physics** **PHE2004C: Foundation of Modern Physics**	CREDIT	4
Semester	IV		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to: 1. Introduction to basic concepts of Modern Physics 2. Learn about thebasics of quantum mechanics 3. Introduction of X-rays and basic solid states physics 4. Introduction of nuclear physics and radioactivity

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Radiation and its nature** (a) Blackbody Radiation, Planck's quantum hypothesis, Planck's constant (derivation of Planck formula is not required). Photoelectric effect, Compton effect,Pair-production, (b) Davisson-Germer experiment. De Broglie wavelength and matter waves. Wave-particle duality. Wave description of particles by wave packets. Heisenberg uncertainty principle and its applications, Group and Phase velocities and relation between them. Double slit experiment. Standing de Brogile waves of electron in Bohr orbits, Diffraction by a single slit. Position of electron in a Bohr orbit. (c) Concept of wave function, Principle of superposition, Time dependent and independent Schrodinger equation, Eigen value equation	15 hrs.
UNIT-II	**Solid State Physics & Crystolography** **Crystal Structure**: Crystalline nature of matter. Cystal lattice, Unit Cell, Elements of symmetry. Crystal systems, Bravais lattices. Miller indices. Simple crystal structures (S.C., BCC, FCC, CsCl, NaCl, diamond and Zinc Blende) **X-ray Diffraction:** Diffraction of X -rays by crystals, Bragg's law, Experimental techniques - Laue's method and powder method. **Bonding in Crystals:** Types of bonding in crystals - characteristics of crystals with different bondings. Lattice energy of ionic crystals - determination of Madelung constant for NaCl crystal.	15 hrs.
UNIT-III	**Nuclear Physics** **Nuclear Structure**: Basic properties of nucleus - size, charge, mass, spin, magnetic dipole moment	15 hrs.

	and electric quadrupole moment. Binding energy of nucleus, deuteron binding energy, p-p, n-n, and n-p scattering (concepts), nuclear forces. Nuclear models- liquid drop model, shell model. **Alpha and Beta Decays**: Range of alpha particles, Geiger - Nuttal law. Gammow's theory of alpha decay. Geiger - Nuttal law from Gammow's theory. Beta spectrum - neutrino hypothesis, **Particle Detectors:** GM-counter, proportional counter, scintillation counter. Elementary particles: Fundamental interaction in nature, classification of elementary particles, Conservation laws.	
Section-II		
UNIT-IV	**List of Experiments:** 1. Boltzmann constant using diode IV characteristics 2. Determination of Fermi Energy of Cu wire 3. Study of Solar cell characteristics 4. Band gap of semiconductor 5. Study of Photo cell	30 hrs

Reference Books

1.	Concepts of Modern Physics, A. Beiser, 2002, McGraw-Hill
2.	Modern Physics, G. Aruldhas and P. Rajagopal, PHI
3.	Modern Physics, R. A. Serway, C. J. Moses and C. A. Moyer, 2012, Thomson Brooks Cole Cengage
4.	Schaum's Outline of Modern Physics, R. Gautreau and W. Savin, 2020, McGraw Hill LLC
5.	Modern Physics for Scientists and Engineers, S. T. Thornton Rex, 4th edition, 2013, Cengage
6.	Introduction to Modern Physics, R. Meyer, Kennard, Coop, 2002, Tata McGraw Hill
7.	Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 201
8.	Learning Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill.Modern Physics, R. Murugeshan, S Chand & Co. Ltd
9.	Schaum's Outline of Beginning Physics II | Waves, electromagnetism, Optics and Modern Physics, A.Halpern, E. Erlbach, McGraw Hill.
10.	Concepts of nuclear physics, B. Cohen, McGraw-Hill Education

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Major Physics** **PHE2014C: Radiation Physics, Biophysical Hazards and Protection**	CREDIT	4
Semester	IV		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Radio Activity** Radioactive Decay, Decay constant and Half-Life of radioactive sample,Mean life, Unites of Radioactivity,Classification of Radiation: Charge and neutral radiation, α,β and γ Emitters. Definitions and examples: Atomic number, atomic mass, isotopes, isotones Interaction of radiation with matter: Charge radiation, gamma interaction, neutron interaction Illustrative examples.	15 hrs.
UNIT-II	**Radiation Detection and Measurement** Concept of Radiation detection, types of detectors used for different radiation detection Characteristics of Gas filled detectors, Giger Muller Counter, Proportional Counter Scintillation and scintillators, Scintillation Counters and gamma spectrometer, Gamma Counters, Autoradiography	15 hrs.
UNIT-III	**Radiation Safety and Health Physics** Biological dose and units: dose, equivalent dose, effective dose Radiation damage: Effect of radiation on biological cell, Biological effects of radiation in human, Biological Hazards of Radiation and Safety Measures in Handling Radioisotopes, Penetration power in living systems, Linear Energy Transfer, Radiation Risk, Radiation Dosimetry, Security of Radioactive material, and Radioactive Management. Radiation protection: Time, distance and shielding concept	15 hrs.

Section-II

UNIT-IV	**List of Experiments:** 1. Characteristics of GM Tube	30 hrs

	2. Inverse square law 3. Effect of different materials on shielding 4. Range of Beta particle in Air (distance increment) 5. Random nature of radioactivity 6. Demonstration of Gamma Spectrometer 7. Measurement of gamma radiation using scintillator detector	

Reference Books	
1.	Radiation Detection and Measurement by G. F. Knoll, Publisher: John Wiley & Sons
2.	Training Course on SAFETY ASPECTS IN RESEARCH APPLICATIONS OFIONISING RADIATIONS, Indian Association of Radiation Protection and RPAD, BARC, Mumbai
3.	S. Sharma (2008) Atomic and Nuclear Physics, Dorling Kindersley (India) Pvt. Ltd. Pearson Education
4.	Nuclear Physics an Introduction by S. B. Patel, New Age International Publisher.

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Skills Enhancement Courses (SEC)**	CREDIT	2
Semester	IV	**SEC2454C: Non Destructive Techniques**	HOURS	30

OBJECTIVES:	The Course Outcome to: 1. To impart knowledge in various methods of Non Destructive Testing. Objective:- 1. Principles of various NDT techniques 2. The equipment required for the NDT 3. The procedure followed in NDT techniques. 4. Applications of NDT and recent trends in NDT

COURSE CONTENT / SYLLABUS

UNIT-I	. Introduction: Non-Destructive testing – Relative Merits and Limitations – NDT vs Mechanical testing. Dry technique and Wet technique – Principle – Applications – Advantages and Limitations. Dyes – Developers – Cleaners. Fluorescent penetrant test. Liquid penetrant inspection. Radiography: X-rays and Gamma rays, Properties of X-rays relevant to NDT – Absorption of rays – scattering. Types and use of Filters – screens – Geometric factors, Film type and Processing. Characteristics of films graininess, Density, Speed, Contrast. Characteristic curves. Characteristics of Gamma rays – fluoroscopy – X-ray – Radiography.Safety with X-rays and Gamma rays.	15 hrs.
UNIT-II	. Ultrasonic Testing: Types of Ultrasonic Waves – Principles of wave propagation – Characteristics of ultrasonic waves – Attenuation. Production of ultrasonic waves – Couplants. Inspection methods – pulse echo, Transmission and Resonance techniques. Thickness measurement.Types of scanning. Test block – Reference blocks.	15 hrs.

Reference Books

1.	J Prasad, C G K Nair, "Non-Destructive Testing and Evaluation of Materials", Tata Mc Graw Hill Education Private Limited.
2.	American Metals Society, " Non-Destructive Examination and Quality Control " Metals Hand, Book, Vol.17, 9th Ed, Metals Park, OH 1989
3.	Bray, Don E and Stanley, Roderic K. " Nondestructive Evaluation A Tool in Design Manufacturing and Service Revised", CRC press New York, Edition 1997.
4.	Cartz L. – 'Non-Destructive testing' – ASM International, Metals Park Ohio, US – 1995
5.	Raj B., Jayakumar T., and Thavasimuthu M. – 'Practical Non-Destructive Testing' – Narosa, New Delhi – 1997
6.	ASM Metals Hand Book, 'Non-Destructive Evaluation and Quality Control' – American Society of Metals, Metals Park Ohio, USA – 1989

Web References

1.	www.ndt-ed,org
2.	www.krautkramer.com.au

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The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**		ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Value Added Courses (VAC)**	CREDIT	2
Semester	IV	**VAC2394C: Basic Instrumentation Skills**	HOURS	30

OBJECTIVES:	**Course objectives**: This course aims to 1. Provide exposure to various aspects of instruments 2. Provide hands-on experience of handling instruments. 3. Teach various debugging techniques for the instruments. **Learning outcomes**: After completing this course the students will be able to 1. Handle various measuring laboratory instruments properly 2. Assess the possible sources of error in the measurements 3. Analyze issues and debug problems in the instrument functioning

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Basic of Measurement** **Basic of Measurement**: Accuracy, precision, sensitivity, resolution range etc. Errors in measurements. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. **Electronic Voltmeter:** Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC milli voltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance. **Cathode Ray Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage oscilloscope: Block diagram and principle of working.	15 hrs.
UNIT-II	***practical: Demonstration and Laboratory*** The test of lab skills will be of the following test items: 1. Use of an oscilloscope.	15 hrs.

	2. CRO as a versatile measuring device. 3. Circuit tracing of Laboratory electronic equipment, 4. Use of Digital multimeter / VTVM for measuring voltages 5. Circuit tracing of Laboratory electronic equipment 6. Measurement of voltage, frequency, time period and phase angle using CRO. 7. Measurement of rise, fall and delay times using a CRO. 8. Measurement of R, L and C using a LCR bridge / universal bridge.	

Reference Books

1.	A textbook in Electrical Technology - B L Theraja - S Chand and Co.
2.	Performance and design of AC machines - M G Say ELBS Edn
3.	Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4.	Logic circuit design, Shimon P. Vingron, 2012, Springer.
5.	Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6.	Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
7.	Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
8.	Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2024-2025**

Name of the Programme: 4 year B.Sc. (Hons.) Programme under NEP2020-Physics

YEAR	II	**Value Added Courses (VAC)**	CREDIT	2
Semester	IV	**VAC2404C: Renewable energy and Energy Harvesting**	HOURS	30

OBJECTIVES:	The Course Outcome to:

COURSE CONTENT / SYLLABUS

UNIT-I	**Fossil fuels and Alternate Sources of energy & Solar energy** **Fossil fuels and Alternate Sources of energy** (8 Lectures) Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Ocean shore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Enenergy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. **Solar energy** (7 Lectures) Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, role of maximum power point tracking for harvesting maximum energy and sun tracking systems.	15 hrs.
UNIT-II	**Wind Energy harvesting & Ocean Energy** **Wind Energy harvesting** (8 lectures) Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. (only idea of synchronisation, current injection, islanding etc with utility grid) **Ocean Energy** (7 lectures) Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.	15 hrs.

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.	Renewable Energy, Power for a sustainable future, Godfrey Boyle, Oxford University Press, in association with The Open University
5.	Solar Energy: Resource Assesment Handbook, Dr. P Jayakumar, 2009
6.	Photovoltaics, J.Balfour, M.Shaw and S. Jarosek, Lawrence J Goodrich (USA)