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

INDEX & COURSE OUTLINE (B.Sc. Physics)

Semester-I

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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Major Physics** **PHM2001C: Mechanics, Waves and Oscillations**	CREDIT	4
Semester	I		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to: 1) Introduction to vector algebra 2) Introduction to basic concepts of Mechanics 3) Understand basics of SHM 4) Applications of Inertial and non-inertial systems. 5) Introduction of various basic physics instruments 6) Introduction to experiments based of Mechanics and Thermal physics 7) Understand basics of different type of pendulum .

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	<<>> Physical interpretation/Concepts of gradient, divergence and curl of physical quantities, vector integration of vector fields, Simple application of Gauss's divergence and Stoke's theorems, Conservative and non-conservative forces, Conservation laws for energy and linear momentum and their associated symmetries. Pseudo-forces in rotating frame: Coriolis force, Galilean transformations of space and time and their relation to Newton's laws of motion, Strong and weak form of the Newton's third law of motion, Difference between Inertial and non-inertial frames, Action-at-a-distance and Mach's principle, Conclusions of Michelson-Morley experiment, Chief arguments against Galilean relativity, Postulates of Special Relativity, Simple ideas of length contraction and time dilation.	15 hrs.
UNIT-II	<<>> Elastic and inelastic collisions and one and two dimensions, Centre of mass frame, Angular momentum, Torque, Conservation of angular momentum and its relation to space coordinates. (*Prerequisites*: Reduction of two body central force problem in to one body problem, concepts of reduced mass, relative and center of mass motion with reduced mass) Motion of Planets, satellites and our solar system, Kepler's laws of planetary motion and their implications, Role of the inverse-square form of Newton's law of gravitation in determination of orbit, Motion of geo-synchronous and geo-stationary satellites, Elementary concepts of Global Positioning System (GPS) based on relativistic mechanics, Structure and motion of our Galaxy due to self – gravity.	15 hrs.
UNIT-III	<<>>	15 hrs.

	Differential equation of simple harmonic motion and its solution, Damped and forced harmonic oscillations, energy conservation and phase space, Coupled oscillator, Transverse and longitudinal wave motion, Sharpness of Resonance, Quality factor, Plane progressive waves in fluid media and pressure and energy distribution along the waves, Transport of energy along strings, Reflection of waves from free and fixed boundaries and phase change at the boundaries, Principle of superposition of waves, Standing waves and resonance, Phase and group velocity.	
Section-II		
UNIT-IV	**List of Experiments:** **MECHANICS** 1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope with error analysis. 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 the modulus of rigidity by statical method. 5. To determine the young's modulus by bending of beam. 6. To determine g by Bar Pendulum. 7. To determine g by Kater's Pendulum. 8. To study the Motion of Spring and calculate (a) Spring Constant (b) Value of g 9. Verification of Melde's law of string. 10. To determine the frequency of A.C. 11. To determine the velocity of sound in an air column.	30 hrs

Reference Books	
1.	Daniel Kleppner and Robert Kolenkow, "An Introduction to Mechanics"(Mc Graw Hill),2017. 2e.
2.	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.
3.	Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 1", Pearson Education Limited, 2012.
4.	Halliday, Resnick and Walker, "Principles of Physics", (Wiley) 2018, 10e.
5.	Frank S. Crawford, Jr, "Waves": Berkeley Physics Course Vol 3", McGraw Hill, 2017.
6.	D.S. Mathur, "Mechanics", S. Chand Publishing, 1981, 3e.
7.	The Physics of vibrations and waves. H. J. Pain (JOHN WILEY & SONS) 5th edition.
8.	R.K. Shukla and Anchal Srivastava, "Mechanics" Published by: New Age International (P) Limited Publishers.
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
	Reference Books (MECHANICS PRACTICAL)
1.	Advanced Practical Physics for students, B. L. Flint and H.T.Worsnop, 1971, Asia Publishing House.

2.	Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Major Physics** **PHM2011C: Optics and Laser Physics**	CREDIT	4
Semester	I		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to: 1) Introduction to basic concepts of optics and laser physics 2) Learn about the physical interpretation of various phenomenon 3) Understand basics of optical instruments 4) Applications of optics and laser. 5) Introduction of various basic physics instruments.

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	<<>> (*prerequisites*: Electromagnetic nature of light; Superposition of light waves; coherence, spatial and temporal coherence; interference, division of wavefront – Young's double slit experiment) Fresnel's Biprism, Lloyd's mirror, Division of amplitude – Thin films (parallel and wedge shaped films), Newton's rings, Interferometers: Michelson's Interferometer, (i) Ideas about form of fringes, (ii) Determination of wavelength, (iii) wavelength difference, (iv) refractive index and visibility of fringes, Fabry - Perot interferometer; Etalon. (*Prerequisites*: Diffraction of light: Fraunhoffer Diffraction & Fresnel Diffraction.) Half period zones, Zone plate, diffraction at a straight edge and narrow wire, Diffraction at circular aperture, diffraction at single and double slits with derivation of equation for intensity and visibility, Diffraction grating, principal maxima and missing orders.	15 hrs.
UNIT-II	<<>> Resolving power, Rayleigh's criterion of resolution, Resolving power of grating and telescope. Polarization: polarization by reflection, polarizing angle, Brewster's law, Law of Malus; Polarization by dichroic crystals, birefringence, anisotropic crystals, Nicol prism, Retarded plates, Babinet compensator, Analysis of polarized light, Optical activity and Fresnel's explanation, Specific rotation, Half shade and Biquartz polarimeters, Jones matrix, matrix representation of plane polarized waves, matrices for polarizers, optical rotators.	15 hrs.
UNIT-III	<<>> Laser theory, Light Amplification, qualitative: threshold condition, Laser rate equations two, three and four level systems, Laser power around threshold, optimum output coupling, Line Broadening Mechanisms–Natural, Collision and Doppler, Optical Resonators – Modes of a rectangular cavity and open planar resonator and optical oscillator.	15 hrs.

	Section-II	
UNIT-IV	**List of Experiments:** **WAVES AND OPTICS** 1. Refractive index of liquid by refraction of light. 2. To determine the critical angle of a given medium using Total Internal Reflection with laser beam. 3. Familiarization with Schuster`s focusing. Determination of angle of prism. 4. To determine Dispersive Power of the Material of a given Prism using Mercury Light 5. To determine the value of Cauchy Constants of a material of a prism 6. To determine thickness of the air wedge through interference 7. To determine wavelength of sodium light using Newton's Rings. 8. To determine wavelength of (1) Sodium & (2) Mercury light using plane diffraction Grating. 9. To study spherical and chromatic aberration by lens.	30 hrs

	Reference Books
1.	F.A. Jenkins and H.E. White, Fundamentals of Optics, Tata McGraw Hill.
2.	Brij Lal and N. Subrahmanyam, Optics, S. Chand.
3.	E. Hecht, Optics, Pearson.
4.	A. K. Ghatak, Optics, Tata Mc Graw Hill.
5.	L. Tarasov, Laser Physics & applications. MIR Publishers
	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
	Reference Books (WAVES PRACTICAL)
1.	Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2.	Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Minor Physics** **PHYE2001C: Mechanics and Modern Optics**	CREDIT	4
Semester	I		HOURS	60

OBJECTIVES:	The Course Outcome to: 1) Introduction of vector algebra 2) Introduction to basic concepts of Mechanics 3) Understand basics of SHM 4) Applications to Inertial and non-inertial systems. 5) Introduction to basic concepts of Optics and laser Physics 6) Learn about the physical interpretation of various phenomenon 7) Understand basics of optical instruments 9) Applications of optics and laser.

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	<<>> Physical interpretation/Concepts of gradient, divergence and curl of physical quantities, Vector integration of vector fields, Simple application of Gauss's divergence and Stoke's curl theorems, Conservative and non-conservative forces, Conservation laws for energy and linear momentum and their relation to symmetries, Pseudo-forces in rotating frame, Coriolis force. Galilean transformations of space and time and their relation to Newton's laws of motion, Strong and weak form of the Newton's third law of motion, Difference between Inertial and non-inertial frames, Conclusions of Michelson-Morley experiment, Postulates of Special Relativity (length contraction and time dilation) Elastic and inelastic collisions and one and two dimensions. Centre of mass frame, Angular momentum, Torque, Conservation of angular momentum and its relation to space coordinates.	15 hrs.
UNIT-II	<<>> (*Prerequisites*: Reduction of two body central force problem in to one body problem, concepts of reduced mass, relative and center of mass motion with reduced mass) Motion of Planets, satellites and our solar system. Kepler's laws of planetary motion and their implications, Role of the inverse-square form of Newton's law of gravitation in determination of orbit. Motion of geo-synchronous and geo-stationary satellites, Elementary concepts of Global Positioning System (GPS) based on relativistic mechanics. Differential equation of simple harmonic motion and its solution, Damped and forced harmonic oscillations, energy conservation and phase space, Coupled oscillator, Transverse and longitudinal wave motion, Sharpness of Resonance, Quality factor, Phase and group velocities.	15 hrs.
	Section-II	

UNIT-III	<<>>	
	(*perquisites*: Electromagnetic nature of light; Superposition of light waves; Coherence, Spatial and temporal coherence; Interference, Division of Wavefront – Young's double slit experiment) Fresnel's Biprism, Lloyd's Mirror; Division of amplitude – Thin films (parallel and wedge shaped films), Newton's rings. Interferometers: Michelson's Interferometer, (i) Idea about form of fringes, (ii) Determination of wavelength, (iii) wavelength difference, (iv) refractive index and visibility of fringes; Fabry-Perot interferometer; Etalon. (*Prerequisites*: Diffraction of light. Fraunhoffer Diffraction & Fresnel Diffraction.) Half period zones, Zone plate, diffraction at a straight edge and narrow wire Diffraction at circular aperture, diffraction at single and double slits with derivation of equation for intensity and visibility; Diffraction grating, principal maxima and missing orders. Resolving power: Rayleigh's criterion of resolution, Resolving power of grating and telescope.	15 hrs.
UNIT-IV	<<>>	
	Polarization: polarization by reflection, polarizing angle, Brewster's law, Law of Malus; Polarization by dichroic crystals, birefringence, anisotropic crystals; Nicol prism, Retardation plates, Babinet compensator; Analysis of polarized light. Optical activity and Fresnel's explanation; Specific rotation. Laser theory, Light Amplification, qualitative: threshold condition, Laser rate equations two, three and four level systems, Laser power around threshold, optimum output coupling, Line Broadening Mechanisms–Natural, Collision and Doppler, Optical Resonators and amplifiers.	15 hrs.

Reference Books (Section-I)

1.	Daniel Kleppner and Robert Kolenkow, "An Introduction to Mechanics",(Mc Graw Hill), 2017. 2e.
2.	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.
3.	Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 1", Pearson Education Limited, 2012.
4.	Halliday, Resnick and Walker, "Principles of Physics", (Wiley) 2018, 10e.
5.	Frank S. Crawford, Jr, "Waves": Berkeley Physics Course Vol 3", McGraw Hill, 2017.
6.	D.S. Mathur, "Mechanics", S. Chand Publishing, 1981, 3e.
7.	The Physics of vibrations and waves. H. J. Pain (JOHN WILEY & SONS) 5th edition.
8.	R.K. Shukla and Anchal Srivastava, "Mechanics" Published by: New Age International (P) Limited Publishers.

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

Reference Books (Section-II)

1.	F.A. Jenkins and H.E. White, Fundamentals of Optics, Tata McGraw Hill.
2.	Brij Lal and N. Subrahmanyam, Optics, S. Chand.
3.	E. Hecht, Optics, Pearson.
4.	A. K. Ghatak, Optics, Tata Mc Graw Hill.
5.	L. Tarasov, Laser Physics & applications. MIR Publishers
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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Multidisciplinary courses (MDC)** **MDC2261C: Concepts of lights**	CREDIT	4
Semester	I		HOURS	60

OBJECTIVES:	The Course Outcome to: 1) Introduction of vector algebra 2) Introduction to basic concepts of Mechanics 3) Understand basics of SHM 4) Applications to Inertial and non-inertial systems 5) Introduction to basic concepts of Optics and laser Physics 6) Learn about the physical interpretation of various phenomenon 7) Understand basics of optical instruments 8) Applications of optics and laser.

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	<<>> Physical interpretation/Concepts of gradient, divergence and curl of physical quantities. Vector integration of vector fields. Simple application of Gauss's divergence and Stoke's curl theorems. Conservative and non-conservative forces, Conservation laws for energy and linear momentum and their relation to symmetries. Pseudo-forces in rotating frame, Coriolis force. Galilean transformations of space and time and their relation to Newton's laws of motion. Strong and weak form of the Newton's third law of motion, Difference between Inertial and non-inertial frames, Conclusions of Michelson-Morley experiment. Postulates of Special Relativity (length contraction and time dilation.) Elastic and inelastic collisions and one and two dimensions, Centre of mass frame, Angular momentum, Torque, Conservation of angular momentum and its relation to space coordinates.	15 hrs.
UNIT-II	<<>> (*Prerequisites*: Reduction of two body central force problem in to one body problem, concepts of reduced mass, relative and center of mass motion with reduced mass) Motion of Planets, satellites and our solar system. Kepler's laws of planetary motion and their implications, Role of the inverse-square form of Newton's law of gravitation in determination of orbit, Motion of geo-synchronous and geo-stationary satellites, Elementary concepts of Global Positioning System (GPS) based on relativistic mechanics. Differential equation of simple harmonic motion and its solution, Damped and forced harmonic oscillations, energy conservation and phase space, Coupled oscillator, Transverse and longitudinal wave motion, Sharpness of Resonance, Quality factor, Phase and group velocities.	15 hrs.
	Section-II	

	<<>>	
UNIT-III	(*perquisites*: Electromagnetic nature of light; Superposition of light waves; Coherence, Spatial and temporal coherence; Interference, Division of Wavefront – Young's double slit experiment) Fresnel's Biprism, Lloyd's Mirror; Division of amplitude – Thin films (parallel and wedge shaped films), Newton's rings. Interferometers: Michelson's Interferometer, (i) Idea about form of fringes, (ii) Determination of wavelength, (iii) wavelength difference, (iv) refractive index and visibility of fringes; Fabry-Perot interferometer; Etalon. (*Prerequisites*: Diffraction of light. Fraunhoffer Diffraction & Fresnel Diffraction.) Half period zones, Zone plate, diffraction at a straight edge and narrow wire Diffraction at circular aperture, diffraction at single and double slits with derivation of equation for intensity and visibility; Diffraction grating, principal maxima and missing orders. Resolving power: Rayleigh's criterion of resolution, Resolving power of grating and telescope.	15 hrs.
	<<>>	
UNIT-IV	Polarization: polarization by reflection, polarizing angle, Brewster's law, Law of Malus; Polarization by dichroic crystals, birefringence, anisotropic crystals; Nicol prism, Retardation plates, Babinet compensator; Analysis of polarized light. Optical activity and Fresnel's explanation; Specific rotation. Laser theory, Light Amplification, qualitative: threshold condition, Laser rate equations two, three and four level systems, Laser power around threshold, optimum output coupling, Line Broadening Mechanisms–Natural, Collision and Doppler, Optical Resonators and amplifiers.	15 hrs.

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3.	Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 1", Pearson Education Limited, 2012.
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2.	Brij Lal and N. Subrahmanyam, Optics, S. Chand.

3.	E. Hecht, Optics, Pearson.
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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Multidisciplinary courses (MDC)**	CREDIT	4
Semester	I	**MDC2241C: Physics of Environment and Atmosphere**	HOURS	60

OBJECTIVES:	1. To know about the physical laws governing the structure and evolution of atmosphere. 2. To learn basic concepts of atmosphere such as weather, climate, hydrological cycle, natural/anthropogenic sources, aerosol-cloud interaction and global warming. 3. To make students aware about various systems comprising the Earth's atmosphere including assessment of relevant parameters and their interpretation. 4. To develop analytic skills to interpret/predict weather systems with the help of utilized parameters, which is in high need during warming climate period.

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	<<>> Evolution of earth and its atmosphere: big bang, formation of stars from gaseous cloud, various galaxies and our solar system, evolution of earth and its atmosphere, changes in the atmosphere during evolution of earth: evolution from reducing atmosphere to an oxidizing atmosphere, earth-sun radiation equilibrium, and green-house effect. Earth's Atmosphere and Importance of Aerosols**:** Atmospheric constituents and their vertical distribution, vertical and horizontal structure of atmosphere: temperature and pressure profiles, troposphere, stratosphere, mesosphere, ionosphere, scale height, Atmospheric radiation budget, Coriolis effect, Ozone hole, Introduction of aerosols, role of aerosols in global climate change: primary and secondary effects.	15 hrs.
UNIT-II	<<>> Hydrological cycle: Hydrological cycle and water budget, cloud types, their formation processes, wet and dry adiabatic lapse rate, various types of precipitates, rain formation process, monsoon system: solar heat distribution on earth, earth's tilt, seasons, south-west and north-east monsoon, cyclones: their formation and death. Global warming and climate change**:** Global warming, natural and anthropogenic sources for warming, long and short - term effects of global warming, components of the climate change process, comparison of various IPCC reports, Important findings of IPCC report, sustainability and our role.	15 hrs.
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UNIT-III	Environmental Physics: Processes & issues. The environment: The science of the 21st century, environmental concerns in the late 20th century. Physics in the environment: Human environment, built environment, urban environment, global environment, biological environment. Environmental physics and the global environmental agenda. Human environment: 1st & 2nd laws of thermodynamics (also for human body), entropy and 3rd law of thermodynamics. Laws of thermodynamics & human body: energy & metabolism. Gibb's free energy. Energy transfer: Conduction, convection, radiation and evaporation. Survival in hot and cold climate. The built environment: Thermal regulation in buildings, thermal insulation, thermal conduction effects, convection effects, radiation effects, Q – values. Buildings of future: check list for future house, energy use and carbon dioxide emission.	15 hrs.
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UNIT-IV	The urban environment (energy in the city) Electromagnetic induction, electric power transmission. (Introduction only) Transportation energy efficiency in transport, water for the urban environment, sewage, Lighting, sources of light, urban pollution, urban pollutants, particulates. Smog, Acid rain. Noise pollution, human ear, sound levels, hearing loses. Energy for living: world energy demand, world energy supplies. Fossil fuels (introduction), Nuclear power, nuclear fission, nuclear reactors, nuclear fusion. Renewable energy: Solar energy, transforming solar energy, solar photovoltaic electricity. Wind power: Average power of a moving mass of fluid, Bernoulli's theorem (Non derivative) and the aerofoil. Forces acting on wind turbine propeller blades, Laminar and turbulent flow.	15 hrs.

Reference Books (Section-I)

1.	An Introduction to Atmospheric Physics 2nd edition by David G. Andrews, , Cambridge University press 2010 1st edition 2000
2.	Fundamental of Atmospheric Physics, Murry L Salby, Academic Press (This volume is the international and Geophysics series.
3.	Fundamental of Atmospheric Modeling, Mark Z Jacobson 2nd edition Cambridge University press.
4.	R. Freedman, Robert Geller and William J. Kaufmann, Universe, W. H. Freedman publishers, 8th edition.
5.	Paul Fleisher, The Big Bang (Great Ideas of Science), twenty-first century books.
6.	David G. Andrews, An introduction to atmospheric physics, Cambridge University press.
7.	Arthur Beiser, Concepts of Modern Physics, Tata McGraw hill, 6th edition.
8.	John Houghton, Physics of Atmospheres, Cambridge University press.
9.	Wallace S. Broecker, How to Build a Habitable Planet, Columbia Univ Trust.
10.	Stanley Q Kidder and Thomas H. Vonder Haar, Satellite Meteorology: An Introduction, Academic Press.
11.	J. T. Houghton, F. W. Taylor and C. D. Rodgers, Remote Sensing of Atmosphere, Cambridge Univ. Press, 1984.
	Reference Books (Section-II)
1.	Environmental physics; sustainable energy & climate change

	EGBERT BOEKER & RIENK VANGRONDELLE (3rd edition) wiley 2011
2.	Foundations of environmental physics (understanding energy use & human impacts) KYLE FORINASH Island press 2010
3.	Introduction to environmental soil physics DANIEL HILLEL. Elsevier Academic Press 2004
4.	Principles of environmental physics; plants, animals & the atmosphere JOHN L MONTEITH; MIKE H. UNSWORTH 4th edition

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Multidisciplinary courses (MDC)**	CREDIT	4
Semester	I	**MDC2251C: Medical Physics**	HOURS	30 + 60

OBJECTIVES:	1) Introduction to basic concepts of medical physics and biophysics 2) Learn about the physical interpretation of various laws behind the biophysics 3) Understand basics of interactions of radiation and detection 4) Applications of radiation detection and measurements.

COURSE CONTENT / SYLLABUS

UNIT-I	**Medical diagnosis tools**: Medical diagnosis tools: Physics as a tool for medical applications, X-ray Machines: Origin of X-rays, physics for X-ray generation in medical apparatus, X-ray image, Applications; MRI: MRI machine principle, theory, applications; Nuclear Magnetic Resonance (Theory and applications); Nuclear medicine; Chemotherapy; Nuclear tracing; Positron Emission Tomography (PET); Applications of laser in medical diagnosis	15 hrs.
UNIT-II	**Radiation physics for human body:** Radiation definition, Classification of nuclear radiation, Interaction of Charge, uncharged, gamma, and neutron radiation with matter, Concept of nuclear detectors and their types, Characteristics of a gas filled detector, Scintillator detectors, NaI Scintillation detector and its working, Interaction of radiation with living cell and body, Dose rate, Equivalent dose rate, quality factors, Effective dose rate, dosemeter, time-distance-shielding concept.	15 hrs.
UNIT-III & IV	**List of Experiments:**	
	1. Understand powder diffraction technique. 2. Study of Geiger Müller Counter – 1: Determination of characteristics of gas filled detector 3. Study of Geiger Müller Counter – 2: Determination of attenuation coefficient 4. Study of Mercury Atomic spectra 5. The diffraction of LASER from the single slit 6. Study of Scintillator detector spectra 7. Study of doserates with time, distance and shielding 8. Total internal reflection 9. Moseley's Law 10. Demonstrate and compare nuclear magnetic resonance 11. Diffraction grating	60 hrs.

Reference Books

1. Principles & Practice of Physics, Eric Mazur, Pearson Publisher

2.	Medical Physics and Biomedical Engineering, B H Brown, Taylor& Francis Publisher
3.	Concepts of Modern Physics, Arthur Baiser, Shobhit Mahajan, S Rai Choudhury, McGraw Hill Education (India) Pvt. Ltd. New Delhi
4.	Nuclear Physics: An Introduction, S. B. Patel, New Edge International Publishers
5.	Physics: Principles with Applications, Douglas Giancoli, Pearson Publisher
6.	Radiation Physics for Medical Physicists, Ervin B. Podgrorsak, Springer Publication
7.	Training Course on Safety Aspects in Research Applications of Ionizing Radiations, P. K. Gaur, Indian Association for Radiation Protection
	Additional Reference Books
1.	Principle of Radiochemistry, D. D. N. Ramamoorthy, A.V. R. Reddy, Indian Association of Nuclear Chemists and Allied Scientists
2.	Introduction to Medical Physics, Stephen Keevil, CRC Press
3.	An Introduction to Medical Physics, Muhammad Maqbool, Springer Publisher
4.	Perez & Brady's Principles and Practice of Radiation Oncology, Edward C. Halperin, Wolters Kluver

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Skills Enhancement Courses (SEC)**	CREDIT	2
Semester	I	**SEC2201C: Experimental Physics-I**	HOURS	60
OBJECTIVES:				

COURSE CONTENT / SYLLABUS

UNIT-I	**List of Experiments:** **MECHANICS** 1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope with error analysis. 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 the modulus of rigidity by statical method. 5. To determine the Young's modulus by bending of beam. 6. To determine g by Bar Pendulum. 7. To determine g by Kater's Pendulum. 8. To study the Motion of Spring and calculate (a) Spring Constant (b) Value of g 9. Verification of Melde's law of string. 10. To determine the frequency of A.C. 11. To determine the velocity of sound in an air column. **WAVES AND OPTICS:** 1. Refractive index of liquid by refraction of light. 2. To determine the critical angle of a given medium using Total Internal Reflection with laser beam. 3. Familiarization with Schuster`s focusing. Determination of angle of prism. 4. To determine Dispersive Power of the Material of a given Prism using Mercury Light 5. To determine the value of Cauchy Constants of a material of a prism 6. To determine thickness of the air wedge through interference 7. To determine wavelength of sodium light using Newton's Rings. 8. To determine wavelength of (1) Sodium & (2) Mercury light using plane diffraction Grating. 9. To study spherical and chromatic aberration by lens.	60 hrs.

Reference Books (MECHANICS)

1.	Advanced Practical Physics for students, B. L Flint and H.T.Worsnop, 1971, Asia Publishing House.
2.	Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

	Reference Books (WAVES)
4.	Advanced Practical Physics for students, B. L. Flint & H.T Worsnop, 1971, Asia Publishing House.
5.	Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
6.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Indian Knowledge System (IKS)**	CREDIT	2
Semester	I	**IKS2191C: Experimental Physics-I**	HOURS	60

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	**List of Experiments:** **MECHANICS:** 1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope with error analysis. 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 the modulus of rigidity by statical method. 5. To determine the Young's modulus by bending of beam. 6. To determine g by Bar Pendulum. 7. To determine g by Kater's Pendulum. 8. To study the Motion of Spring and calculate (a) Spring Constant (b) Value of g 9. Verification of Melde's law of string. 10. To determine the frequency of A.C. 11. To determine the velocity of sound in an air column. **WAVES AND OPTICS:** 1. Refractive index of liquid by refraction of light. 2. To determine the critical angle of a given medium using Total Internal Reflection with laser beam. 3. Familiarization with Schuster`s focusing. Determination of angle of prism. 4. To determine Dispersive Power of the Material of a given Prism using Mercury Light 5. To determine the value of Cauchy Constants of a material of a prism 6. To determine thickness of the air wedge through interference 7. To determine wavelength of sodium light using Newton's Rings. 8. To determine wavelength of (1) Sodium & (2) Mercury light using plane diffraction Grating. 9. To study spherical and chromatic aberration by lens.	60 hrs.

Reference Books (MECHANICS)

1.	Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2.	Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

	Reference Books (WAVES)
4.	Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
5.	Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
6.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Indian Knowledge System (IKS)**	CREDIT	2
Semester	I	**PHY XXXX: Electronics in daily life**	HOURS	30

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	<<>> Semiconducting materials and their Types, 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 capacitor filter, Zener Diode and Voltage Regulation. Different number systems and conversion: Binary, Octa decimal, Hexadecimal, BCD, Logic gates: AND, OR, NOT and Universal gates, Boolean Algebra, De Morgan Theorem, Introduction of ICs.	15 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

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Indian Knowledge System (IKS)**	CREDIT	2
Semester	I	**PHY XXXX: Physics of sounds and visual arts**	HOURS	30

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	<<>> **Waves and Sound**: Wave Nomenclature, Sound Waves, Orchestral Sound, Wave Interference. **Resonance:** Introduction to Musical Instruments, Wave Impedance Modes, overtones, and harmonics: Interpreting Musical Instrument Power Spectra, Beginning to Think About Musical Scales, Beats **Musical Scales:** Consonance, The Pythagorean Scale, The Just Intonation Scale, The Equal Temperament Scale, A Critical Comparison of Scales, create a Musical Scale, Evaluating Important Musical Scales **Stringed Instruments:** Sound Production in Stringed Instruments, The Guitar, Building a Three Stringed Guitar. **Wind Instruments:** The Mechanical Reed, Lip and Air Reeds, Open Pipes, Closed Pipes, The End Effect, Changing Pitch, More About Brass Instruments, More about Woodwind instruments, The Nose flute, The Sound Pipe, The Toy Flute, The Trumpet, Building a Set of PVC Panpipes. **Percussion Instruments:** Bars or Pipes with Both Ends Free, Bars or Pipes With One End Free, Toward a "Harmonic" Idiophone, The Harmonica, The Music Box Action, Building a Copper Pipe Xylophone. Acoustics of auditorium and amphitheatre (only qualitative).	15 hrs.
UNIT-II	<<>> **The Eye:** The Cornea and Lens, The Iris, The "Humorous" Liquids of the Eye. The Retina, Dark Adaptation, Depth perception. Characterizing Light Sources Color Filters and Pigments, Characterization of a Light Beam, Spectral Intensity vs. Intensity, Color Filters, Stacking Filters (Filters in Series), Pigments, Summary Comments on Filters and Pigments. **Theory of Color Vision:** A Simplified Version of the Three-Primary Theory(RGB), Exploration of Color Mixing with a Computer, Introduction to the Chromaticity Diagram, Metamers, A Crude Chromaticity Diagram, A Chromaticity Diagram of Practical Use, The Units for the Admixture of the Three Primaries, Tristimulus Values, Color Coordinates, On the Significance of the Chromaticity Diagram, The Calculation of Color	15 hrs.

	Coordinates, Color Coordinates of Butter, Using a Different Set of Primaries, General Features of a Different Set of Primaries, The Standard Chromaticity Diagram of the C. I. E., From Computer RGB Values to Color, How Many Colors Are There?, Limitations of a Broadened Gamut of a Monitor, A Simple Physiological Basis for Color Vision, Color and vision Blindness, After-Images.	

Reference Books	
1.	The physics of music and musical instruments By David R. Lapp,
2.	Music Engineering by Richard Brice second edition Newness, (Oxford Boston Johannesburg Melbourne New Delhi Singapore)
3.	Good Vibrations. The Physics of Music by Barry Parker The John Hopkins University Press
4.	The Physics of music and color by Luen Gunther Springer publications
5.	Color and light (Concept and confusion) by Herald Arnkil, Karin Fridell Anter Aalto University Publication Series

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Indian Knowledge System (IKS)**	CREDIT	2
Semester	I	**IKS2201C:- Mathematical Physics: Essential for Biologist**	HOURS	30

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	<<>> **Introduction, Graphs and Functions:** Introduction, Graphs and Functions, Equations as Graphs, periodic, trigonometric and exponentials Functions, Logarithmic and Other Functions (of at least two variables). **Function and its Derivatives, Computing Derivatives of Curves:** Images as 2D/3D Functions, Functions and its Derivatives, Computing Derivatives of Curves , Rules for Calculating Derivatives, Understanding Derivatives. **Plotting Curves, Numerical Calculation of Derivatives, Partial Derivatives:** Curvature and Second Derivative, Plotting Curves ,Numerical Calculation of Derivatives, Function, Derivatives and Series Expansion, L'Hopital's Rule and Partial Derivatives.	15 hrs.
UNIT-II	<<>> **Integration and their Graphical Understanding:** Integration and its Rules, Graphical Understanding and its Examples, Product of Two Functions, relation between derivation and integration, basic concept of partial integration. **Vectors: Position and Movement in 2D, Cell Symmetry: Use of Polar Coordinates:** Exponential growth and Decay, Scalars and Vectors, Vectors: Position and Movement in 2D, Cell Symmetry: Use of polar Coordinates, Gradient. Forces and Flows, Diffusion, Diffusion Constant and Einstein Relation, Diffusion Equation, Diffusion vs. Active Transport.	15 hrs.

Reference Books

1.	Mathematics for Biological Scientists, M. Aitken, B. Broadhursts, S. Haldky, Garland Science (2009)

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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Major Physics** **PHM2002C: Heat and Thermodynamics**	CREDIT	4
Semester	II		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to: 1) Introduction to basic concepts of thermal physics, 2) Learn about the physical interpretation of various laws of thermal physics, 3) Understand basics of Gas kinetics, 4) Applications to mono-atomic and diatomic gases. 5) Introduction of various basic physics instruments 6) Introduction to experiments based of Thermal physics 7) Understand basics of different type of pendulum 8) Applications of inertial and non-inertial systems

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Introduction to Thermodynamics** (a) Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, Internal Energy and First Law of Thermodynamics, Its differential form, First Law & various processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient. (b) Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work, Heat Engines, Carnot's Cycle, Carnot engine & efficiency, Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. (c) Carnot's Theorem, Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. (d) Concept of Entropy, Clausius Theorem, Clausius Inequality, Second Law of Thermodynamics in terms of Entropy, Entropy of a perfect gas, Principle of Increase of Entropy, Entropy Changes in Reversible and Irreversible processes with examples, Entropy of the Universe, Principle of Increase of Entropy, Temperature- Entropy diagrams for Cycle, Third Law of Thermodynamics, Unattainability of Absolute Zero.	15 hrs.
UNIT-II	**Thermodynamic Potentials** (a) Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy, Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature, Magnetic Work, Cooling due	15 hrs.

	to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation. (b) Maxwell's Thermodynamic Relations. Derivations and applications of Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Values of C_P -C_V, (3) T- dS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. (c) Joule-Thomson Porous Plug Experiment: Joule- Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule Thomson Cooling.	
UNIT-III	**Kinetic Theory of Gases** (a) Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification, Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds, Degrees of Freedom, Law of Equipartition of Energy (No proof required), Specific heats of Gases. (b) Molecular Collisions: Mean Free Path. Collision Probability, Estimates of Mean Free Path, Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance. (c) Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation, Andrew's Experiments on CO_2 Gas, Critical Constants, Continuity of Liquid and Gaseous State. Vapor and Gas. Boyle Temperature, Van der Waal's Equation of State for Real Gases, Values of Critical Constants, Law of Corresponding States, Comparison with Experimental Curves, P-V Diagrams, Conduction of Heat, Thermal conductivity, diffusivity, Fourier's equation for heat conduction its solution for rectilinear flow of heat.	15 hrs.
	Section-II	
UNIT-IV	**List of Experiments**:	
	THERMAL PHYSICS 1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method. 2. To measure the temperature coefficient of resistance using P. O. Box. 3. To verify Newton's law of cooling, and to determine the specific heat of liquid. 4. To determine Stefan's Constant. 5. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus. 6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method. 7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer. 8. To study the variation of thermo emf across two junctions of a thermocouple with temperature using Seebeck effect 9. To study the variation of thermo emf across two junctions of a thermocouple with temperature using Peltier effect 10. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system	30 hrs.
	Reference Books	
1.	Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill	

2.	Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa
3.	Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
4.	Thermodynamics, E. Fermi, 2007, Sarat Book House
5.	Basic Thermodynamics, E. Guha, 2010, Narosa
6.	Kinetic theory of gases, Loeb, Radha Publishing House
7.	A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press
Additional Reference Books	
1.	Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
2.	Thermodynamics and an introduction to thermostatistics, H. B. Callen, 1985, Wiley
3.	Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications
4.	Elements of Classical Thermodynamics A.B. Pippard, 1957, Cambridge University Press
5.	Equilibrium Thermodynamics, C.J. Adkins, 1983, Cambridge University Press
6.	Principles of Thermodynamics, M. Kaufman, 2002, CRC Press
Reference Books (THERMAL PHYSICS)-PRACTICAL	
1.	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.
2.	Electricity and magnetism by D Chattopadhyay and P C Rakshit (New Central book agency, Kolkatta)
3.	Electromagnetism by B B Laud 2nd Edition, Wiley eastern limited
4.	Electricity and Magnetism with Electronics by K. K. Tiwari (S. Chand & Company Ltd. 2007)
5.	Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4^{th} Edition, reprinted 1985, Heinemann Educational Publishers
6.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11^{th} Edition, 2011, Kitab Mahal, New Delhi.
7.	A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal, 1985, Vani Publication.

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Major Physics** **PHM2012C: Electricity and Magnetism**	CREDIT	3
Semester	II		HOURS	45 + 30

OBJECTIVES:	The Course Outcome to: 1) Introduction to basic concepts of Electricity and Magnetism, 2) Understanding the dielectric properties of matter, 3) Solving the problems based on Electro static 4) Understand the basics of magneto statics, 5)Understand the magnetic properties of magneto statics, 6) Applications to electromagnetic induction theory, 7) Understand the basics of AC circuits and various problems 8) Introduction of various basic physics instruments 9) Introduction to experiments based of Electricity and Magnetism 10) Understand basics of different type of pendulum 11) Applications of inertial and non-inertial systems

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Electrostatics, Dielectric properties of matter &Electrostatic Energy** **Electrostatics:**(*Prerequisites*: Coulomb's law, principle of superposition, electrostatic field. Electric field and charge density, surface and volume charge density, charge density on the surface of a conductor. Force per unit area on the surface.) Divergence of the Electrostatic field, flux, Gauss's theorem of electrostatics, applications of Gauss theorem to find Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Curl of the Electrostatic Field, Conservative nature of electrostatic field, Introduction to electrostatic potential, Calculation of potential for linear, surface and volume charge distributions, potential for a uniformly charged spherical shell and solid sphere, Calculation of electric field from potential. **Dielectric properties of matter:** Electric dipole moment, electric potential and field due to an electric dipole, force and Torque on a dipole. Electric Fields inside matter, Electric Polarisation, bound charges, displacement density vector, relation between $\vec{E}$, $\vec{P}$and $\vec{D}$. Gauss's theorem in dielectrics, Dielectric medium and its properties. **Method of Images:** Laplace's and Poisson equations. Uniqueness Theorems. Method of Images and its application to: Plane Infinite metal sheet, Semi-infinite dielectric medium and metal Sphere. **Electrostatic Energy:** Electrostatic energy of system of charges. Electrostatic	15 hrs.

	energy of a charged sphere. Energy per unit volume in electrostatic field.	
UNIT-II	**The Magnetostatic Field & Magnetic properties of matter** **The Magnetostatic Field:** Biot-Savart's law, Application of Biot-Savart's law to determine the magnetic field of a straight conductor, circular coil, Force on a moving point charge due to a magnetic field: Lorentz force law. Force between two straight current carrying wires. Divergence of the magnetic field and its solenoidal nature, Magnetic vector potential, calculation for simple cases. Curl of the magnetic field. Ampere's circuital law, Its application to (1) Infinite straight wire, (2) Infinite planar surface current, and (3) Infinite Solenoid. **Magnetic properties of matter:** Potential and field due to a magnetic dipole, Magnetic dipole moment, Force and torque on a magnetic dipole in a uniform magnetic field, Magnetization, Bound currents, The magnetic intensity $\vec{\mathbf{H}}$. Relation between $\vec{\mathbf{B}}$, $\vec{\mathbf{H}}$ and $\vec{\mathbf{M}}$ **,** Linear media, Magnetic Susceptibility and Permeability, Boundary conditions for $\vec{\mathbf{B}}$ and $\vec{\mathbf{H}}$. Brief introduction of dia-, para- and ferro-magnetic materials. B-H curve and hysteresis.	15 hrs.
UNIT-III	**Electro-magnetic induction & Electrical circuits** **Electro-magnetic induction** Ohms law (macroscopic) and definition of *e.m.f.* Faraday's laws of electromagnetic induction, Lenz's law, Self-Inductance and Mutual Inductance, Introduction to Maxwell's Equations, Charge conservation: Displacement current and resurrection of Equation of Continuity, Reciprocity Theorem. **Electrical circuits** AC Circuits: Kirchhoff's laws for AC circuits, Complex Reactance and Impedance, Series and parallel LCR Circuits: Resonance, Power Dissipation, Quality Factor and bandwidth.	15 hrs.
Section-II		
	List of Experiments:	
UNIT-IV	**ELECTRICITY AND MAGNETISM** 1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses. 2. Ballistic Galvanometer: i. Measurement of charge and current sensitivity ii. Measurement of CDR 3. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx). 4. To study the Characteristics of a Series RC Circuit. 5. To determine a Low Resistance by Carey Foster's Bridge. 6. To verify the Thevenin and Norton theorem 7. To verify the Superposition, and Maximum Power Transfer Theorem 8. To determine the magnetic field using deflection magnetometer in Gauss – A and Gauss – B position. 9. To determine the magnetic field using vibration magnetometer 10. To develop the understanding of magnetic inductance.	30 hrs.

Reference Books

1.	E.M. Purcell, "Electricity and Magnetism (In SI Units): Berkeley Physics Course Vol 2", McGraw Hill, (2017), 2e.

2.	Richard P. Feynman, Robert B. Leighton, Matthew Sands, “The Feynman Lectures on Physics - Vol. 2”, Pearson Education Limited, (2012).
3.	David J. Griffiths, “Introduction to Electrodynamics” 4th Edition, (Cambridge Univ. Press 2020)
4.	W.K.H Panofsky and M. Philips, “Classical Electricity and Magnetism” (Dover Books on Physics, 2012)
5.	Arthur F. Kip, “Fundamentals of Electricity and Magnetism”, (McGraw- Hill, 1968)
6.	J.H. Fewkes& John Yarwood, “Electricity and Magnetism”, Vol. I (Oxford Univ. Press, 1991).
7.	B B Laud, “Electromagnetics”, New Age International (P) Limited.
8.	D.C. Tayal, “Electricity and Magnetism”, Himalaya Publishing House Pvt.Ltd., 2019, 4e
9.	N. Wadhwani, “Electricity and magnetism”, PHI Learning, ISBN: 9788120339651, 9788120339651
10.	R.K. Shukla, “Introduction to Electricity & Magnetism”, HP Hamilton Limited
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
Reference Books (ELECTRICITY AND MAGNETISM)-PRACTICAL	
1.	Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3.	Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Minor Physics** **PHE2002C: Thermal & Electromagnetic fields**	CREDIT	4
Semester	II		HOURS	60

OBJECTIVES:	The Course Outcome to: 1) Introduction to basic concepts of Thermal Physics 2) Learn about the physical interpretation of various laws of thermal physics 3) Understand basics of Gas kinetics, 4) Applications to mono-atomic and diatomic gases. 5) Introduction to basic concepts of Electricity and Magnetism, 6) Understanding the dielectric properties of matter, 7) Solving the problems based on Electro statics 8) Understand the basics of magneto statics, 9) Understand the magnetic properties of magneto statics, 10) Applications to electromagnetic induction theory, 11) Understand the basics of AC circuits and various problems

COURSE CONTENT / SYLLABUS

Section- I

UNIT-I	**Introduction to Thermodynamics** **Introduction to Thermodynamics:** (*Prerequisites*: Zeroth, First and Second Laws of Thermodynamics and their physical relevance.) Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. Concept of Entropy, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples Principle of Increase of Entropy. Temperature- Entropy diagrams for Cycle. **Thermodynamic Potentials:** (a) Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy, Their Definitions, Properties and Applications. Surface Films and First and second order Phase Transitions with examples. (b) Maxwell's Thermodynamic Relations. Derivations and applications of Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Values of C_P -C_V , (3) T – dS Equation, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. (c) Joule-Thomson Porous Plug Experiment: Joule- Thomson Effect for Real and Van der Waal Gases. Temperature - Inversion. Joule Thomson Cooling.	15 hrs.
UNIT-II	**Kinetic Theory of Gases** (a) Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof	15 hrs.

	required). Specific heats of Gases. (b) Molecular Collisions: Mean Free Path. Collision Probability. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. (c) Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapor and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Comparison with Experimental Curves? P-V Diagrams. Conduction of Heat, Thermal conductivity, diffusivity.	
Section- II		
UNIT-III	**Electrostatics & The Magnetostatic Field** **Electrostatics:** (*Prerequisites*: Coulomb's law, principle of superposition, electrostatic field. Electric field and charge density, surface and volume charge density, charge density on the surface of a conductor. Force per unit area on the surface.) Divergence of the Electrostatic field, flux, Gauss's theorem of electrostatics, applications of Gauss theorem to find Electric field due to point charge, infinite line of charge, charged conductor. Curl of the Electrostatic Field, Conservative nature of electrostatic field, Introduction to electrostatic potential, Calculation of potential for linear, surface and volume charge distributions, potential for a uniformly charged spherical shell and. Calculation of electric field from potential. **The Magnetostatic Field:** Biot - Savart's law. Application of Biot-Savart's law to determine the magnetic field of a straight conductor, circular coil. Lorentz force law, Force between two straight current carrying wires, (Same direction and opposite direction.) Divergence of the magnetic field and its solenoidal nature. Magnetic vector potential, calculation for simple cases. Curl of the magnetic field. Ampere's circuital law, Its application to (1) Infinite straight wire.	15 hrs
UNIT-IV	**Magnetic properties of matter & Electro-magnetic induction** **Magnetic properties of matter:** Potential and field due to a magnetic dipole, Magnetic dipole moment. Force and torque on a magnetic dipole in a uniform magnetic field, Magnetization, Bound currents, The magnetic intensity $\vec{\mathbf{H}}$. Relation between $\vec{\mathbf{B}}$, $\vec{\mathbf{H}}$ and $\vec{\mathbf{M}}$ **,** Linear media, Magnetic Susceptibility and Permeability, Boundary conditions for $\vec{\mathbf{B}}$ and $\vec{\mathbf{H}}$. Brief introduction of dia-, para- and ferro-magnetic materials. B-H curve and hysteresis. **Electro-magnetic induction** Ohms law and definition of E.M.F. Self-Inductance and Mutual Inductance. Introduction to Maxwell's Equations. Charge conservation. AC Circuits: Kirchhoff's laws for AC circuits. Series & parallel LCR Circuit: resonance, power dissipation and quality factor, and band Width analysis/calculation.	15 hrs

Reference Books (Section- I)

1.	Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill
2.	Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa

3.	Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
4.	Thermodynamics , E. Fermi, 2007 , Sarat Book House
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6.	Principles of Thermodynamics , M. Kaufman, 2002, CRC Press
	Reference Books(Section- II)
1.	E.M. Purcell, "Electricity and Magnetism (In SI Units): Berkeley Physics Course Vol 2", McGraw Hill, (2017), 2e.
2.	Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 2", Pearson Education Limited, (2012).
3.	David J. Griffiths, "Introduction to Electrodynamics" 4th Edition, (Cambridge Univ. Press 2020)
4.	W.K.H Panofsky and M. Philips, "Classical Electricity and Magnetism" (Dover Books on Physics, 2012)
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6.	J.H. Fewkes& John Yarwood, "Electricity and Magnetism", Vol. I (Oxford Univ. Press, 1991).
7.	B B Laud, "Electromagnetics", New Age International (P) Limited.
8.	D.C. Tayal, "Electricity and Magnetism", Himalaya Publishing House Pvt.Ltd., 2019, 4e
9.	N. Wadhwani, "Electricity and magnetism", PHI Learning, ISBN: 9788120339651, 9788120339651
10.	R.K. Shukla, "Introduction to Electricity & Magnetism", HP Hamilton Limited
	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

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Multidisciplinary courses (MDC)**	CREDIT	4
Semester	II	**MDC2242C: Elements of thermodynamics and Electromagnetism**	HOURS	60

OBJECTIVES:	The Course Outcome to: 1) Introduction to basic concepts of Thermal Physics , 2) Learn about the physical interpretation of various laws of thermal physics , 3) Understand basics of Gas kinetics, 4) Applications to mono-atomic and diatomic gases. 5) Introduction to basic concepts of Electricity and Magnetism, 6) Understanding the dielectric properties of matter, 7) Solving the problems based on Electrostatic , 8) Understand the basics of magneto statics, 9) Understand the magnetic properties of magneto statics, 10) Applications to electromagnetic induction theory, 11) Understand the basics of AC circuits and various problems

COURSE CONTENT / SYLLABUS

Section-I

UNIT-I	**Introduction to Thermodynamics** **Introduction to Thermodynamics:** (*Prerequisites*: Zeroth, First and Second Laws of Thermodynamics and their physical relevance.) Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale, Concept of Entropy, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy, Entropy Changes in Reversible and Irreversible processes with examples Principle of Increase of Entropy, Temperature- Entropy diagrams for Cycle. **Thermodynamic Potentials:** (a) Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy, Their Definitions, Properties and Applications. Surface Films and First and second order Phase Transitions with examples, (b) Maxwell's Thermodynamic Relations. Derivations and applications of Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Values of C_P -C_V , (3) T – dS Equation, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. (c) Joule-Thomson Porous Plug Experiment: Joule- Thomson Effect for Real and Van der Waal Gases. Temperature - Inversion. Joule Thomson Cooling.	15 hrs.
UNIT-II	**Kinetic Theory of Gases**	15 hrs.

	(a) Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. (b) Molecular Collisions: Mean Free Path. Collision Probability. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. (c) Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapor and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Comparison with Experimental Curves? P-V Diagrams. Conduction of Heat, Thermal conductivity, diffusivity.	
Section-II		
UNIT-III	**Electrostatics & The Magnetostatic Field** (*Prerequisites*: Coulomb's law, principle of superposition, electrostatic field. Electric field and charge density, surface and volume charge density, charge density on the surface of a conductor. Force per unit area on the surface.) Divergence of the Electrostatic field, flux, Gauss's theorem of electrostatics, applications of Gauss theorem to find Electric field due to point charge, infinite line of charge, charged conductor. Curl of the Electrostatic Field, Conservative nature of electrostatic field, Introduction to electrostatic potential, Calculation of potential for linear, surface and volume charge distributions, potential for a uniformly charged spherical shell and Calculation of electric field from potential. **The Magnetostatic Field:** Biot - Savart's law. Application of Biot-Savart's law to determine the magnetic field of a straight conductor, circular coil. Lorentz force law. Force between two straight current carrying wires (Same direction and opposite direction.) Divergence of the magnetic field and its solenoidal nature, Magnetic vector potential, calculation for simple cases. Curl of the magnetic field. Ampere's circuital law, Its application to (1) Infinite straight wire.	15 hrs.
UNIT-IV	**Magnetic properties of matter & Electro-magnetic induction** **Magnetic properties of matter:** Potential and field due to a magnetic dipole, Magnetic dipole moment. Force and torque on a magnetic dipole in a uniform magnetic field, Magnetization, Bound currents, The magnetic intensity $\vec{\mathbf{H}}$. Relation between $\vec{\mathbf{B}}$, $\vec{\mathbf{H}}$ and $\vec{\mathbf{M}}$ **,** Linear media, Magnetic Susceptibility and Permeability, Boundary conditions for $\vec{\mathbf{B}}$ and $\vec{\mathbf{H}}$. Brief introduction of dia-, para- and ferro-magnetic materials. B-H curve and hysteresis. **Electro-magnetic induction** Ohms law and definition of E.M.F. Self-Inductance and Mutual Inductance. Introduction to Maxwell's Equations. Charge conservation. AC Circuits: Kirchhoff's laws for AC circuits. Series & parallel LCR Circuit: resonance, power dissipation and quality factor, and band Width analysis/calculation.	15 hrs.
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1.	Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill	

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4.	W.K.H Panofsky and M. Philips, "Classical Electricity and Magnetism" (Dover Books on Physics, 2012)
5.	Arthur F. Kip, "Fundamentals of Electricity and Magnetism", (McGraw- Hill, 1968)
6.	J.H. Fewkes& John Yarwood, "Electricity and Magnetism", Vol. I (Oxford Univ. Press, 1991).
7.	B B Laud, "Electromagnetics", New Age International (P) Limited.
8.	D.C. Tayal, "Electricity and Magnetism", Himalaya Publishing House Pvt.Ltd., 2019, 4e
9.	N. Wadhwani, "Electricity and magnetism", PHI Learning, ISBN: 9788120339651, 9788120339651
10.	R.K. Shukla, "Introduction to Electricity & Magnetism", HP Hamilton Limited
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

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Multidisciplinary courses (MDC)**	CREDIT	4
Semester	II	**MDC2252C: Physics of Biosystems and its Informatics**	HOURS	60

OBJECTIVES:	The Course Outcome to: 1) To provide bioinformatics graduates with a solid foundation in physics principles and concepts relevant to their field. 2) The course will enable students to understand the physical principles underlying various biological phenomena, computational modeling techniques, and data analysis in bioinformatics research.

COURSE CONTENT / SYLLABUS

	Section-I	
UNIT-I	**Forces** **Forces**: Cohesive Forces, Hydrogen Bonding, Electrostatics -unscreened and screened Electrostatic Interactions, The Force Between Charged Spheres in Solution, Steric and Fluctuation Forces, Depletion Forces, Hydrodynamic Interactions, Direct Experimental Measurements of Inter- molecular and Surface Forces, Mechanical properties of biomaterials.	15 hrs.
UNIT-II	**Dynamics** **Dynamics**: Assembly and activity of biomolecules - Folding and unfolding dynamics of molecules, coil-globule transition, phase changes, chemical equilibria and kinetics, biomolecular diffusion, motility of micro-organisms, Low Reynold's number dynamics, Signal transmission in neurons – ion channels and pumps, action potential.	15 hrs.
	Section-II	
UNIT-III	**Introduction to Physics in Bioinformatics:**	15 hrs.
	Introduction to Physics in Bioinformatics: Overview of the course objectives and structure, Introduction to physics principles and their relevance to bioinformatics, Discussion on the interdisciplinary nature of bioinformatics. Classical Mechanics: Newton's laws of motion, Forces and motion in biological systems, Conservation laws (energy, momentum, angular momentum), Applications of classical mechanics in bioinformatics (e.g., molecular dynamics simulations).	
UNIT-IV	**Thermodynamics & Statistical Mechanics**	15 hrs.
	Thermodynamics: Laws of thermodynamics, Enthalpy, entropy, Gibb's and Helmholtz free energy, biological systems and thermodynamic principles, Applications of thermodynamics in bioinformatics (e.g., protein folding, metabolic networks). Statistical Mechanics:	

	Boltzmann distribution and partition function, Statistical analysis of biological data Applications of statistical mechanics in bioinformatics (e.g., protein structure prediction, sequence alignment).	
Reference Books(Section-I)		
1.	Applied Biophysics - A Molecular Approach for Physical Scientists, By Tom A. Waigh, John Wiley & Sons, Ltd	
2.	The Molecules of Life – Physical and chemical principles By John Kuriyan,BoyanaKonforti, David Wemmer, Taylor and Francis.	
Reference Books(Section-II)		
1.	Nelson, Philip Charles, et al. Biological physics: energy, information, life. No. QH505 N44. New York: WH Freeman, 2008.	
2.	Nelson, Philip, Sarina Bromberg, Ann M. Hermundstad, Keith Kroma-Wiley, and Jason Prentice. "Physical models of living systems: probability, simulation, dynamics."	

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Skills Enhancement Courses (SEC)** **SEC2202C: Experimental Physics-II**	CREDIT	2
Semester	II		HOURS	60

OBJECTIVES:	The Course Outcome to: 1) Introduction of various basic physics instruments 2) Introduction to experiments based of Thermal physics and Electricity and Magnetism 3) Understand basics of different type of pendulum

COURSE CONTENT / SYLLABUS

UNIT	**List of Experiments:** **THERMAL PHYSICS:** 1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method. 2. To measure the temperature coefficient of resistance using P. O. Box. 3. To verify Newton's law of cooling, and to determine the specific heat of liquid. 4. To determine Stefan's Constant. 5. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus. 6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method. 7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer. 8. To study the variation of thermo emf across two junctions of a thermocouple with temperature using Seebeck effect 9. To study the variation of thermo emf across two junctions of a thermocouple with temperature using Peltier effect 10. To record and analyze the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system **ELECTRICITY AND MAGNETISM** 1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses. 2. Ballistic Galvanometer: i. Measurement of charge and current sensitivity ii. Measurement of CDR 3. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx). 4. To study the Characteristics of a Series RC Circuit. 5. To determine a Low Resistance by Carey Foster's Bridge. 6. To verify the Thevenin and Norton theorem 7. To verify the Superposition, and Maximum Power Transfer Theorem 8. To determine the magnetic field using deflection magnetometer in Gauss – A and Gauss – B position. 9. To determine the magnetic field using vibration magnetometer 10. To develop the understanding of magnetic inductance.	60 hrs.

Reference Books (THERMAL PHYSICS)	
1.	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.
2.	Electricity and magnetism by D Chattopadhyay and P C Rakshit (New Central book agency, Kolkatta)
3.	Electromagnetism by B B Laud 2nd Edition, Wiley eastern limited
	Electricity and Magnetism with Electronics by K. K. Tiwari (S. Chand & Company Ltd. 2007)
4.	Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
5.	A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
6.	A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, 1985, Vani Publication.
	Reference Books (ELECTRICITY AND MAGNETISM)
1.	Advanced Practical Physics for students, B. L. Flint & H.T.Worsnop, 1971, Asia Publishing House.
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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Value Added Courses (VAC)** **VAC2102C: Experimental Physics-II**	CREDIT	2
Semester	II		HOURS	60

OBJECTIVES:	The Course Outcome to: 1) Introduction of various basic physics instruments 2) Introduction to experiments based of Thermal physics and Electricity and Magnetism 3) Understand basics of different type of pendulum (W.r.to centre of mass & centre of symmetry, mass distribution)

COURSE CONTENT / SYLLABUS

UNIT	**List of Experiments:** **THERMAL PHYSICS:** 1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method. 2. To measure the temperature coefficient of resistance using P. O. Box. 3. To verify Newton's law of cooling, and to determine the specific heat of liquid. 4. To determine Stefan's Constant. 5. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus. 6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method. 7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer. 8. To study the variation of thermo emf across two junctions of a thermocouple with temperature using Seebeck effect 9. To study the variation of thermo emf across two junctions of a thermocouple with temperature using Peltier effect 10. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system **ELECTRICITY AND MAGNETISM** 1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses. 2. Ballistic Galvanometer: i. Measurement of charge and current sensitivity ii. Measurement of CDR 3. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx). 4. To study the Characteristics of a Series RC Circuit. 5. To determine a Low Resistance by Carey Foster's Bridge. 6. To verify the Thevenin and Norton theorem 7. To verify the Superposition, and Maximum Power Transfer Theorem 8. To determine the magnetic field using deflection magnetometer in Gauss – A and Gauss – B position. 9. To determine the magnetic field using vibration magnetometer	60 hrs.

	10. To develop the understanding of magnetic inductance.	
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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Value Added Courses (VAC)** **VAC2162C: Physics of Human motion**	CREDIT	2
Semester	II		HOURS	30

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	<<>> Introductory Mechanics – Statics and Dynamics – Basic Principles. The human body as a biomechanical system – basic terminologies. Kinematics of muscles and joints - free-body diagrams and equilibrium, forces and stresses in joints. Biomechanical analysis of joints - Shoulder, Elbow, wrist, hand, fingers, Spine, Leg, Hip, Knee, and Ankle.	15 hrs.
UNIT-II	<<>> Introduction to Postural stability and Gait analysis. Gait analysis in health and disease – basics. Mechanics of Hard Tissues - Definition of Stress and Strain, Deformation Mechanics, structure and mechanical properties of bone - cortical and cancellous bones, Wolff's law of bone remodeling; Soft Tissues - Structure, functions, material properties – tendon function, elasticity in a tendon, models of non-linear elasticity in a tendon – physiological and non-physiological regimes.	15 hrs.

Reference Books

1.	David A. Winter, Biomechanics and Motor Control of Human Movement.
2.	Margareta Nordin and Victor H. Frankel, Basic Biomechanics of the Musculoskeletal System.
3.	Francisco Valero-Cuevas, Fundamentals of Neuro mechanics
4.	Susan Hall, Basic Biomechanics.
5.	Irving Hermann, Physics of Human Body.

	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Value added courses (VAC)**	CREDIT	2
Semester	II	**VAC2172C: Econophysics**	HOURS	30

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	**Introduction to Econophysics:** **Introduction to Econophysics:** Concept of econophysics, History of Econophysics and key-contributors, comparison of traditional economics and Econophysics, methods of Econophysics. Supply and demand, efficient market hypothesis its concepts, Paradigm and variables, stocks and derivatives, options.	15 hrs.
UNIT-II	**Thermal and statistical physics for the econophysics** Basic concept of statistical mechanics: equilibrium and non- equilibrium systems, ensemble, partition function and probability distribution, Maxwell-Boltzmann distribution, Bose-Einstein distribution, Fermi-Dirac distribution, Boltzmann-Gibb's distribution and its applications in economics and finance, Thermodynamics analogies in economics, such as temperature, entropy and free energy, random walk.	15 hrs.

Reference Books

1.	Econophysics: An introduction by Sitabhra Sinha, Arnab Chatterjee, Anirban Chakraborti and Bikas K. Chakraborti
2.	Econo physics and Socio physics by Arnab Chatterjee, Anirban Chakraborti and Bikas K. Chakraborti

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	The Maharaja Sayajirao University of Baroda Faculty/College of **Faculty of Science**, Department of **Physics**	ACADEMIC YEAR **2023-2024**

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

YEAR	I	**Value Added Courses (VAC)** **VAC2182C: Python for Physical Sciences**	CREDIT	2
Semester	II		HOURS	30

OBJECTIVES:	

COURSE CONTENT / SYLLABUS

UNIT-I	<<>> **Introduction of Python:** 1. Python Syntax for input –output, 2. for – loop, While - loop 3. Conditional statements 4. Data representation using Plots 5. List, List of list (two dimensional array) 6. Introduction of numpy, pyplot, scipy molecules of python 7. Function definition 8. Integration and differentiation in python 9. Symbolic calculation in python	15 hrs.
UNIT-II	<<>> **Python Programs for Physics problems:** 1. Installing and operating Pydroid application 2. Errors analysis of micrometer screw from given data set 3. Evaluate η using Maxwell's needle experiment. 4. Calculate Y.M. of wire from given data set 5. Evaluate spring constant from graph 6. Evaluate frequency of frock using melde's experiment 7. Graphical Representation of ideal SHM, damped SHM, forced SHM 8. Solution of equation of motion in 1 D (Projectile motion) 9. Simulation of Kepler's law 10. Study of Black body Radiation (Stefan's Law) 11. Quantum uncertainty in the harmonic oscillator. 12. Derivative of the sampled function.	15 hrs.

Reference Books

1.	Fundamentals of Programming Python by Richard L. Halterman, 2019
2.	Computational Physics by Mark Newman, University of Michigan
3.	A primer on Scientific Programming with Python
4.	Essential Python for Physicist, Giovanni Moruzzi (e book) 2020, Springer
5.	Starting out with python by Tony Gaddis, Pearson, 4th edition, Global edition 2019
6.	Python for everybody Charles R. Severance, 2009
7.	F.Y.B.Sc. Physics Sem-I practical Tutorials