

# **COURSE HANDOUTS**

**Semester I, Academic Session 2023-2024**

**(B.Sc. Courses in Physics under WBSU Regulation of 2023)**

## Mathematical Methods – I (DS1)

1<sup>st</sup> semester, 2023-2024

### About the Course

- Name of the Course : Mathematical Methods - I
- Nature of the Course : Core Course
- Credit point : 3 (Theory) + 2 (Laboratory)
- Class Hours : 45 (Theory) + 60 (Laboratory)

### Course Objective

The aim of this freshmen level course is to introduce to the students advanced calculus including ordinary differential equations and vector calculus.

### Course Outcomes

**CO1 : Recapitulation** of basics of Calculus. **Understanding** of approximation through Taylor and Binomial series. **Understanding** of calculus of functions of more than one variable.

**CO2 : Learn** to solve first and second order ordinary differential equation.

**CO3 : Recapitulation** of basics of vector calculus. **Understanding** of geometric and algebraic nature of vectors.

**CO4 : Learn** differentiation and integration involving vectorial quantities.

**CO5 : Learn** plotting functions and data and curve fitting using gnuplot. Learn to use python programming language to solve simple mathematical problems.

### Relationship to other courses

- Prerequisite : Grasp on 10 + 2 level mathematics
- Follow up courses : DS5, DS8, DS17

**Course Coordinators** : Dr. Purnendu Chakraborty and Prof. Paramita Mallick

**Course Schedule**

DS1 – Theory				
Faculty	Timetable			Google Classroom Code
Dr. Purnendu Chakraborty	Monday	11 :00 – 12 : 00	Physics Laboratory	ztkvfs
Prof. Paramita Mallick	Tuesday	13:00 – 14:00	Physics Laboratory	ys3risy
	Thursday	12:00 – 13:00	Physics Laboratory	
DS1 – Practical				
Dr. Purnendu Chakraborty	Monday	15:00 – 17:00	Computer Laboratory	ztkvfs
	Saturday	10:00 – 12:00	Computer Laboratory	

## Course Outline (DS1)

<b>Module I - Calculus</b>
<p>Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). Convergence condition of Taylor series and corresponding tests.</p> <p>First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous and Inhomogeneous Equations with constant coefficients, particular integral. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.</p> <p>Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.</p>
<b>Module 2 – Vector Calculus</b>
<p>Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities using Kronecker delta and Levi-civita symbols.</p> <p>Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements.</p> <p>Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).</p>
<b>Reference Books</b>
<ol style="list-style-type: none"><li>1. Mathematical methods in the Physical Sciences, M. L. Boas, 2005, Wiley.</li><li>2. Vector Analysis with an Introduction to Tensor Analysis, Schaum's Outline Series. M.R. Spiegel, 1981, McGraw Hill.</li><li>3. Introduction to Mathematical Physics. C. Harper, 1989, PHI.</li><li>4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.</li><li>5. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.</li><li>6. Essential Mathematical Methods, K. F. Riley &amp; M. P. Hobson, 2011, Cambridge University Press</li></ol>

**Course Calendar (DS1)**

<b>Dr. Purnendu Chakraborty</b>			
<b>Module</b>	<b>Topic</b>	<b>Class Hour</b>	<b>Month</b>
<b>1</b>	<b>Calculus</b>	<b>18</b>	
1A	Recapitulation : Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions.	3	August
1B	Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). Convergence condition of Taylor series and corresponding tests.	3	September
1C	Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.	3	September October
	<b>Class Test (CO1)</b>	<b>1</b>	<b>October</b>
1D	First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous and Inhomogeneous Equations with constant coefficients, particular integral. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.	7	November December
	<b>Class Test (CO2)</b>	<b>1</b>	<b>December</b>

Paramita Mallick			
Module	Topic	Class Hours	Month
<b>2</b>	<b>Vector Calculus</b>	<b>27</b>	
2A	Recapitulation of vectors : Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.	06	August
	<b>Class Test (C03)</b>	01	August
2B	Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities using Kronecker delta and Levi-civita symbols.	07	August September
	Discussion of problems and doubts	01	September
	<b>Class Test (C04)</b>	01	October
2C	Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).	09	October November December
	Discussion of problems and doubts	01	December
	<b>Class Test (CO4)</b>	01	December

## Mechanics (Minor Course in Physics)

1<sup>st</sup> semester, 2023-2024

### About the Course

- Name of the Course : Mechanics
- Nature of the Course : Minor Course
- Credit point : 3 (Theory) + 2 (Laboratory)
- Class Hours : 45 (Theory) + 60 (Laboratory)

### Course Objective

This is a freshmen level course on Newtonian mechanics and general properties of matter. In the laboratory, the students will get hands on learning experience of the concepts that are taught in the theory classes.

### Course Outcomes

**CO1 : Comprehend** basic vector calculus – products, derivatives and integration of vectorial quantities. **Learn** to solve first order and second order homogeneous and inhomogeneous ordinary differential equations.

**CO2 : Understand** Newton's laws of motion and application in particle dynamics. **Understand** the conservation laws.

**CO3 : Learn** Newtonian theory of gravitation and applications.

**CO4 : Understand** simple harmonic motion and the properties of systems executing such motions.

**CO5 : Acquire** knowledge about elasticity.

**CO6 : Acquire** hands on training experience to verify concepts learned in the theory class.

### Relationship to other courses

- Prerequisite : Grasp over 10 + 2 level physics and mathematics

**Faculty :** Dr. Priyanka Chowdhury, Dr. Mahuya Chakrabarti

## Course Schedule

Minor Course - Theory				
Faculty	Timetable			Google Classroom Code
Priyanka Chowdhury	Monday	14: 00 – 15:00	M-114	qlhk52q
	Friday	14:00 – 15:00	M-114	
Mahuya Chakrabarti	Thursday	12:00 – 13:00	M-114	yvcuxk2
Minor Course - Practical				
Priyanka Chowdhury	Tuesday	14:00 – 16:00	Physics Laboratory	
Mahuya Chakrabarti	Wednesday	14:00 – 16:00	Physics Laboratory	

## Course Outline

<b>Module 1 – Mathematical Methods</b>	<b>(10 Hours)</b>
<p>Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.</p> <p>Ordinary Differential Equations: 1 st order homogeneous differential equations. 2 nd order homogeneous and inhomogeneous differential equations with constant coefficients.</p>	
<b>Module 2 – Particle Dynamics</b>	<b>(14 Hours)</b>
<p>Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.</p> <p>Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.</p> <p>Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum</p>	
<b>Module 3 – Gravitation</b>	<b>(7 Hours)</b>
<p>Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness.</p>	
<b>Module 4 – Oscillations</b>	<b>(6 Hours)</b>
<p>Oscillations: Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. Forced harmonic oscillations, resonance.</p>	
<b>Module 5 – Elasticity</b>	<b>(8 Hours)</b>
<p>Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio- Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion Torsional pendulum.- Bending of beam.</p>	
<b>Reference Books</b>	
<p>(1) Introduction to Mathematical Physics. C. Harper, 1989, PHI.</p> <p>(2) An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.</p> <p>(3) Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.</p> <p>(4) Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.</p> <p>(5) Classical Mechanics and General Properties of Matter. S.N. Maiti and D.P. Raychaudhuri, New Age</p> <p>(6) Introduction to Classical Mechanics, R. G. Takwale and P. S. Puranik, 1979, Tata McGraw-Hill</p> <p>(7) Elements of Properties of Matter, D.S. Mathur, 2008, S. Chand and Company Limited</p>	

## Course Calendar

Priyanka Chowdhury			
Module	Topic	Class Hours	Month
<b>1</b>	<b>Mathematical Methods</b>	<b>10</b>	
1A	Vectors : Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.	3	August
1B	Ordinary Differential Equations : 1 <sup>st</sup> order homogeneous differential equations. 2 <sup>nd</sup> order homogeneous and inhomogeneous differential equations with constant coefficients.	6	August September
	<b>Class Test (C01)</b>	<b>1</b>	September
<b>3</b>	<b>Gravitation</b>	<b>7</b>	
3A	Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only).	4	September
3B	Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness.	3	September October
<b>4</b>	<b>Oscillations</b>	<b>6</b>	
4A	Oscillations: Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages.	3	October
4B	Damped oscillations. Forced harmonic oscillations, resonance.	3	November
<b>5</b>	<b>Elasticity</b>	<b>7</b>	
5A	Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio- Expression for Poisson's ratio in terms of elastic constants.	2	November December
5B	Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional pendulum.	2	December
5C	Bending of beam.	2	December
	<b>Class Test (C03, C04, C05)</b>	<b>1</b>	December

Mahuya Chakrabarti			
Module	Topic	Class Hours	Month
<b>2</b>	<b>Particle Dynamics</b>	<b>14</b>	
2A	Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.	3	August
2B	Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.	3	September
	<b>Class Test (C02)</b>	<b>1</b>	September
2C	Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.	6	October – December
	<b>Class Test (C02)</b>	<b>1</b>	December

## Basic Instrumentation Skills

1<sup>st</sup> Semester, 2023-2024

### About the Course

- Name of the Course : Basic Instrumentation skills
- Nature of the Course : Skill Enhancement Course (Physics)
- Code of the Course :
- Credit point : 3 (Theory + Laboratory)
- Class Hours : 45 (Theory + Laboratory)

### Course Description

The course is designed to develop basic instrumental skill among students.

### Course Outcomes

**CO1 : Develop** fundamental skill to handle basic measuring instruments.

**CO2 : Learn** about electronic voltmeter and will be able to use it efficiently.

**CO3 : Understand** about CRO and its efficient use.

**CO4 : Acquire** knowledge about signal generators, impedance bridge and Q-meter.

**CO5 : Develop** knowledge about digital instruments and will be able to handle digital meters.

### Relationship to other courses

This course will help students to perform laboratory class more confidently.

**Course Coordinator** : Dr Raghu Nath Bera

### Course Schedule

Faculty	Timetable			Google Classroom Code
Raghu Nath Bera	Tuesday	11:00 – 12:00	Physics Laboratory	igbt2qe
	Thursday	14:00 – 16:00	Physics Laboratory	

**Course Outline (Theory) :**

<b>Unit 1 : Basic of Measurement</b>
Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter : Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.
<b>Unit 2 : Electronic Voltmeter</b>
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 millivoltmeters: Amplifier-rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.
<b>Unit 3 : Cathode Ray Oscilloscope</b>
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.
<b>Unit 4 : Signal Generators and Analysis Instruments</b>
Block diagram, explanation and specifications of low frequency signal generators. Pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis
<b>Unit 5 : Digital Instruments</b>
Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.
<b>Unit 6 : Digital Multimeter</b>
Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/frequency counter, time-base stability, accuracy and resolution
<b>Reference Books</b>
1) A text book 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.

**Course calendar (Theory)**

Unit	Topic	Class Hour	Month
1. Basic of Measurement	Basic idea about measuring instruments: Accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of DC & AC voltage, current and resistance. Specifications of a multimeter and their significance.	3	August
2. Electronic Voltmeter	Advantage of electronic voltmeter over conventional multimeter. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.	3	August
3. 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. Signal a) Electronic components and measuring devices and their general characteristics	3	September
		3	September
4. Signal Generators and Analysis Instruments	Block diagram, explanation and specifications of low frequency signal generators. Pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis	3	October
5. Digital Instruments	Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter	3	November
6. Digital Multimeter	Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution	3	December

## Course Outline (Laboratory)

The test of lab skills will be of the following test items :

1. Use of an oscilloscope.
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, (Same as 3 )
6. Winding a coil / transformer.
7. Trouble shooting a circuit
8. Balancing of bridges

### Laboratory Exercises

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. Measurement of voltage, frequency, time period and phase angle using CRO.
4. Measurement of time period, frequency, average period using universal counter/ frequency counter.
5. Measurement of rise, fall and delay times using a CRO.
6. Measurement of distortion of a RF signal generator using distortion factor meter.

### Plan of Laboratory sessions

Expt No	Description of the Experiment	Time allotted (hr)*	Month
1	To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.	2	August
2	To observe the limitations of a multimeter for measuring high frequency voltage and currents.	2	August
3	Measurement of voltage, frequency, time period and phase angle using CRO.	6	September
4	Measurement of time period, frequency, average period using universal counter/ frequency counter.	4	October
5	Measurement of rise, fall and delay times using a CRO.	6	November, December
6	Measurement of distortion of a RF signal generator using distortion factor meter.	4	December

\*This is tentative time allocation. Students have to carry out the experiment by their own under the supervision of the teacher. Some students may complete it in shorter time and some may need longer time. Unavoidable circumstances like power cut and/or instrumental problem may also arise during experiment leading to delay.

## Current Perspectives of Physics (Multidisciplinary Course)

1<sup>st</sup> semester, 2023-2024

### About the Course

- Name of the course : Current Perspectives of Physics
- Nature of the course : Multidisciplinary Course in Physics
- Credit point : 3
- Class Hour : 45 Hours

### Course Objective

To give an overview of some basic physical ideas at a semi-popular level with minimal use of mathematics.

### Course Outcomes

**CO1 :** To **acquire** qualitative idea of Systems, Observers, Reference frames and Forces originating from the fundamental Interactions of nature.

**CO2 :** To **understand** how physics works

**CO3 :** To **understand** the grand scheme of physics

**CO4 :** To **understand** dual nature of light

**CO5 :** To **acquire** qualitative idea of the entire electromagnetic spectrum

### Course Prerequisite

High school level exposure of physical science, algebra and geometry.

**Faculty :** Faculty 1, Faculty 2, Faculty 3

### Course Schedule

Faculty	Time Table			Google Classroom
Paramita Mallick	Wednesday	10:00 – 11:00	M-114	mkpnzzw
Purnendu Chakraborty	Friday	10:00 – 11:00	M-114	dvt4rtx
Mahuya Chakrabarti	Monday	10:00 – 11:00	M-114	4l4j2xr

## Course Outline

<b>Module 1 : Introduction</b>	<b>(14 Hours)</b>
<p>(a) <b>Introduction</b> : Qualitative idea of Systems, Observers, Reference frames and Forces originating from the fundamental Interactions of nature, long-range (gravity and electromagnetic) and short-range (strong and weak forces).</p> <p>(b) <b>How Physics works</b> : Examples of how observations lead to discovery of Laws of nature, how theories are constructed around these laws, how experiments verify theoretical predictions and theories are modified to suit the experimental findings.</p> <p><b>Examples :</b></p> <p>(i) Galilean and Newtonian Dynamics giving Laws of motion, Kepler's laws of Planetary motion explained by Newton's theory of gravity, Discovery of Neptune as a verification of Newton's gravity theory, Newton's gravitational constant.</p> <p>(ii) Different empirical laws of Electromagnetism (Coulomb's law, Faraday's law, Ampere's law etc) connected by Maxwell's theory, Prediction of electromagnetic wave and its speed of propagation as a Universal constant. Inconsistency with laws of Galilean Relativity leading to discovery of Special Relativity.</p> <p>(iii) Observation of atomic spectra and Black-body radiation leading to Planck's quantum theory and Einstein's explanation of Photoelectric effect introducing Photon as a "quanta of energy".. Discovery of Bohr model of atom. Development of quantum mechanics, Planck's constant – a fundamental constant of nature.</p>	
<b>Module 2 : The grand scheme of Physics</b>	<b>(13 Hours)</b>
<p><b>The three fundamental constants of nature, <math>c</math>, <math>G</math> and <math>\hbar</math> .</b></p> <p>(a) Classical non-relativistic mechanics: the starting point.</p> <p>(b) Classical relativistic mechanics, SR, Electrodynamics</p> <p>(c) Classical Newtonian gravity, falling bodies, Structure of solar system, Galaxies.</p> <p>(d) Classical General relativity, curved space-time, fine tuning of planetary motion, perihelion precession of Mercury, deflection of light by the Sun, recent observational evidence of Blackholes and Gravitational waves as predicted by theory.</p> <p>(e) Relativistic quantum mechanics, it's inconsistencies leading to Quantum field theory which explains sub-atomic structures, fundamental particles, standard model (LHC).</p> <p>(f) Theory of Quantum Gravity, yet to be formalised.</p>	
<b>Module 3 : Light</b>	<b>(18 Hours)</b>
<p><b>(a) Light and it's dual nature :</b></p> <p>Corpuscular and wave theories of light- a historical overview; merits and demerits of the two theories; simple experiments demonstrating dispersion of light using prism, diffraction of light with laser source, demonstration of Newton's rings and its qualitative explanation; naïve idea of black body radiation, Planck's proposal of energy quanta, photoelectric effect and particle nature of light; Scattering of light, Raman effect (qualitative).</p> <p><b>(b) The Electromagnetic Spectrum :</b></p> <p>Introduction to the entire electromagnetic spectrum; Light as an electromagnetic wave (mention Maxwell's theory, Hertz's experiment); usage of different parts of the electromagnetic spectrum with examples from everyday life including x-rays and gamma-rays in medical science, microwaves and radio waves (mentioning</p>	

India's Radio telescope site at GMRT), preliminary concepts of LASER, Holography and Fibre optics.

#### Reference Books

1. Perspectives of Modern Physics, Arthur Beiser, McGraw-Hill Inc.,US, 1969.
2. The Feynman Lectures on Physics - Vol. I, II & III, Pearson Education; Combo edition, 2012.
3. At the root of Things, The subatomic world, Palash B. Paul, CRC Press, 2014.
4. কী দিয়ে সমস্তকিছু গড়া, পলাশ বরন পাল, পশ্চিমবঙ্গ রাজ্য পুস্তক পর্ষদ, ২য় সংস্করণ, ১৯৯৭
5. Seven Brief Lessons On Physics, Carlo Rovelli, Penguin Random House, UK, 2014.

## COURSE CALENDAR

Paramita Mallick			
Module	Module description	Class Hour	Month
<b>1</b>	<b>Introduction</b>	<b>14</b>	
1A	<b>Introductory Idea</b> : Qualitative idea of Systems, Observers, Reference frames and Forces originating from the fundamental Interactions of nature, long-range (gravity and electromagnetic) and short-range (strong and weak forces).	2	August
1B	<b>How Physics works</b> : Examples of how observations lead to discovery of Laws of nature, how theories are constructed around these laws, how experiments verify theoretical predictions and theories are modified to suit the experimental findings.	–	–
1B.a	Galilean and Newtonian Dynamics giving Laws of motion, Kepler's laws of Planetary motion explained by Newton's theory of gravity, Discovery of Neptune as a verification of Newton's gravity theory, Newton's gravitational constant.	4	August September
1B.b	Different empirical laws of Electromagnetism (Coulomb's law, Faraday's law, Ampere's law etc) connected by Maxwell's theory, Prediction of electromagnetic wave and its speed of propagation as a Universal constant. Inconsistency with laws of Galilean Relativity leading to discovery of Special Relativity.	3	September
1B.c	Observation of atomic spectra and Black-body radiation leading to Planck's quantum theory and Einstein's explanation of Photoelectric effect introducing Photon as a "quanta of energy". Discovery of Bohr model of atom. Development of quantum mechanics, Planck's constant – a fundamental constant of nature.	4	November December
	<b>Class test (CO1 and CO2)</b>	1	December

**Purnendu Chakraborty**

Module	Module description	Class Hour	Month
<b>2</b>	<b>The grand scheme of Physics</b>	<b>13</b>	
	<b>The three fundamental constants of nature, <math>c</math>, <math>G</math> and <math>h</math> .</b>		
2A	(a) Classical non-relativistic mechanics: the starting point. (b) Classical relativistic mechanics, Special Relativity, Electrodynamics	3	August
2B	Classical Newtonian gravity, falling bodies, Structure of solar system, Galaxies.	3	September
2C	Non-relativistic quantum mechanics, basic structure of atoms, molecules, solid state physics.	4	September October
2D	Classical General relativity, curved spacetime, fine-tuning of planetary motion, perihelion precession of Mercury, deflection of light by the Sun, recent observational evidence of Black- holes and Gravitational waves as predicted by theory.	2	November
	<b>Class Test (CO3)</b>	<b>1</b>	<b>December</b>

## Mahuya Chakrabarti

Module	Module description	Class Hour	Month
<b>3</b>	<b>Light</b>	<b>18</b>	
3A	<b>Light and it's dual nature</b> : Corpuscular and wave theories of light- a historical overview; merits and demerits of the two theories; simple experiments demonstrating dispersion of light using prism, diffraction of light with laser source, demonstration of Newton's rings and its qualitative explanation; naïve idea of black body radiation, Planck's proposal of energy quanta, photoelectric effect and particle nature of light; Scattering of light, Raman effect.	10	August September October
3C	<b>The Electromagnetic Spectrum</b> : Introduction to the entire electromagnetic spectrum; Light as an electromagnetic wave (mention Maxwell's theory, Hertz's experiment); usage of different parts of the electromagnetic spectrum - with examples from everyday life including x-rays and gamma-rays in medical science, microwaves and radio waves (India's Radio telescope site at GMRT), preliminary concepts of LASER, Holography and Fibre optics.	8	November December
	<b>Class Test (CO4 and CO5)</b>		