ROYAL GLOBAL UNIVERSITY
GUWAHATI

Royal School of Applied and Pure Sciences

Department of Physics

B.Sc. (Hons.) Physics

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Preamble

Education is the backbone of a nation. It is the most powerful sector and acts as the key for the success of the nation. On the other hand, students are the pillar of a nation who will lead the nation in the times to come. So, the synergy between the education system of a country and its student community is vital for the sustainable development of the nation. This interdependency necessitates the dynamic nature of the education system and demands the change with time.

To inhabit this dynamics requirement the Choice Based Credit System (CBCS) has been introduced in the education system of India in the recent past. The CBCS offers the student community to choose the subjects of their interest from the number of other disciplines besides their core filed.

To enhance the involvement of the student-teacher in the teaching-learning process, the University Grants Commission (UGC) has recently initiated the Learning Outcome-based Curriculum Framework (LOCF) in the structure of the undergraduate programs to be offered by the Higher Educational Institutions. This framework focuses on the outcome-based syllabus with well-defined aims, objectives, and goals to achieve. It aims direct interactions among the teachers and students which helps the students to easily recognize the purpose of each course and can understand their learning need. It also aims to clearly state the objectives to be achieved at the end of the successful completion of each program. The key components planned in LOCF are

- A detailed description of the Graduate Attributes (GA)
- Qualification Descriptors (QD)
- Program Learning Outcomes (PLO)
- Course Learning Outcomes (CLO)

The CBCS curriculum of B.Sc. (Hons.) Physics is focused on developing a comprehensive understanding of the subject matter and to the need of the students to understand the basics of Physics, its applications, explaining the natural phenomenon and future perspective.

The curriculum has well-defined objectives and Learning Outcomes. LOCF approach in B.Sc. (Hons.) Physics is adopted to make the course more flexible and to provide multiple options for the students to enhance their skills in the field of physics and interdisciplinary areas. The curriculum has been designed with sound theoretical and experimental knowledge so that the student can easily get adjusted themselves into the academic and industrial environment after their successful completion.

1. Introduction to B.Sc. (Hons.) Physics

The B.Sc. (Hons.) Physics curriculum has been developed to train the student with theoretical and practical knowledge of the subject matter using CBCS methodology. The curriculum also aims to provide sound training to pursue research in the field of Physics or any other interdisciplinary areas.

The learning outcomes of the course are designed in such a way that the students understand the objectives of the course which enable them to realize the usefulness of the applied sciences for the wellbeing of the humankind and the natural environment. The course contents include both fundamentals as well as upcoming developments in the field of Physics and interdisciplinary branches of sciences.

2. Program Duration and Design

The B.Sc. (Hons.) Physics course is a three-year program with a total of six semesters. The course includes core theory papers and core practical papers in the first to fourth semesters. These semesters also include generic electives from broad disciplines. Ability Enhancement Compulsory Courses (AECC), Communicative English throughout all semesters, Behavioral Science, Environmental Science **A**bility Enhancement Elective Courses (Skill-Based) are other

highlights of the B.Sc. (Hons.) Physics course. In the fifth and sixth semester, the curriculum includes one Discipline Selective Elective (DSE) subjects in each semester. Further, the inclusion of a graduate seminar in the fifth semester and project of 6 credit are some of the major highlights of the curriculum. The including of the graduate seminar helps the student community to learn the Information and Communication Technology (ICT) method like the use of PowerPoint presentations conventional teaching-learning method. Further, the inclusion of the project as a part of the curriculum provides an opportunity to the student to carry out research work, participate in different industrial and institutional visits, seminars and workshops etc. and eventually help them to enhance their carrier prospects.

3. Learning Outcome-based Curriculum Framework in B.Sc. (Hons.) Physics

The B.Sc. (Hons) Physics course curriculum and syllabus are framed on the outcome-based teaching-learning process. The Learning Outcomes-based Curriculum Framework (LOCF) for the B.Sc. (Hons.) degree in Physics offers a broad and balanced structural framework that includes all the current curricular needs. The course aims at mesmerizing the student to acquire knowledge, skills understanding, values, graduate attributes, and academic standards. Each course in the program is designed with clear instructional objectives which are mapped to the student outcomes. An extensive range of advanced elective courses is available within the department and across the disciplines. Students awarded B.Sc. (Hons.) physics-based on this skills-based curriculum will help them in making the right choice in their future endeavors.

4. Nature and extent of the B.Sc. (Hons.) Physics

Physics is the study of natural science. It has a wide range of applications in natural sciences, engineering, medical sciences etc. The key areas of study in Physics are:

- Mechanics
- Optics and laser
- Waves and oscillation

- Electricity and magnetism
- Electrodynamics
- Thermodynamics
- Concept of nucleus
- Electronics
- Matter and its constituent
- Mathematical physics
- Relativity
- Quantum mechanics
- Statistical mechanics
- Digital system and applications
- Astrophysics

The B.Sc. (Hons) Physics course curriculum has been designed by considering the above branches of physics with the aim to form the solid foundation in the field. Besides the core subjects, the program structure provides an opportunity for the students to choose subjects from the prescribed courses comprising inter-disciplinary, departmental elective courses, and skill-based enhancement courses and Ability Enhancement Compulsory Courses (AECC). This will help the student to peruse their carrier in academic or industries.

5. Aims of B.Sc. (Hons.) Program in Physics

The overall aims of the B.Sc. (Hons) Physics Program are to:

- Create a strong interest in learning Physics.
- Provide an in-depth understanding of the basic concepts of physical sciences
- Enable the students to acquaint with suitable tools and skills of Physics
- Solid understanding of the fundamental areas of modern Physics
- The students will understand the principles and application of physical science to address problems in a variety of disciplines.
- Assist the students to become more capable, competent as well as confident in their performances which will eventually make them employable or risk-taker in their future endeavors.

6. Graduate attributes

In general, learning of new and innovative things attracts the students who pursue the undergraduate program in science stream. The

additional attributes which distinguish a student studying Physics (Hons.) are mentioned below.

- Disciplinary knowledge: Ability to demonstrate comprehensive knowledge of physics and its subfields, and its applications to one or more disciplines. The student should be knowledgeable enough to correlate the concerned theory with practical experiments.
- Communication skills: Communication is important in any discipline. The physics discipline is not an exception. The student is expected to have the required this skill to accumulate information and convey the same to the intended audience in an intelligent way in terms of oral presentation as well as a written document.
- Critical thinking: It enables the student to think about a problem in an analytical way to produce a logical solution.
- Problem-solving: Problem-solving is an integral part of the physics syllabus. The student is expected to be equipped with the necessary analytical and critical thinking abilities.
- Analytical reasoning: The student should develop the skill of logical conclusions based on knowledge, facts, and observations. Potentiality to think and inquire about relevant/appropriate questions, ability to define problems, formulate and test hypotheses, formulate physical arguments and proofs, draw conclusions; ability to present results.
- To know about the developments in various branches of physics
- Cooperation/Team works: In general, a class is consisting of students from diverse fields. The student should behave with classmates in an accommodative as well as meaningful way.
- Scientific reasoning: A student should inculcate the expertise of investigating a phenomenon in terms of scientific reasoning.
- Reflective thinking: It helps the student to make a judgement about some happenings based on their experiences.
- Information/Digital literacy: Computer literacy about laboratory work in analyzing/fitting data; and the additional skill of handling computer-mediated instruments create this attribute.
- Self-directed learning: Students are advised to explore all kinds of

relevant information accessible to them which will enrich themselves and lead to self-education.

- Multicultural competence: A student should realize that all are unique in their way irrespective of their cultural backgrounds, religious thoughts, and socio-economic status.
- Moral and ethical awareness/reasoning Ability to identify unethical behavior such as fabrication or misrepresentation of data, committing plagiarism, infringement of intellectual property rights and adopting an objective, unbiased and truthful actions in all aspects.
- Leadership qualities: Leadership quality is a very coveted characteristic for students which, in turn, lead to a very effective class environment.
- Lifelong learning: All the students should be motivated and groomed in such a way that they become life-long learners to become a responsible and contributing citizen to society.

7. Qualification Descriptors

The B.Sc. Physics (Hons) course includes a wide range of topic from different branches of physics. In the qualification descriptors category of this course, the following points may be included.

- Understanding of in-depth concepts of different domains in physical science through theory and experiment
- Development of theoretical and practical knowledge to become specialized in the subject matter.
- Application of experimental techniques, ability to use modern instrumentation for chemical analysis, analysis of data, and employing modern library search tools to locate and assess information to solve physics-related problems.
- Dissemination of acquired results in a scientific manner in the range of different contexts
- Exhibit inclusive knowledge about physics in context to current research
- Establish the capability to identify and organize proper resources to develop a project or scientific report by maintaining ethical conduct.

- Development of knowledge and capability to participate fruitfully in a physics-related discussion and contribute to solving the problem of the discussion.
- Make capable to explore opportunities in the field of physics and related branches for jobs, research, or businesses.
- Use knowledge, understanding and expertise to solve the real-life problem prevailed in the society.
- Application of the physical concepts for the sustainable development of the county
- Exploring advanced and new topics in physical science through the application of existing knowledge and understanding.

8. Program Learning Outcomes in B.Sc. (Hons.) Physics

The student pursuing the B.Sc. (Hons.) Physics program will undergo several theoretical and laboratory experiments that will help them understand the subject matter both qualitatively and quantitatively. On completion of this course, a student will be able to

- Building a critical understanding of the subject matters
- Enhanced the knowledge to explain the physics theorem and technique.
- Effectively communicate the concept of physics in effective ways.
- Development of new and innovative idea in the branch of physics and related fields.
- Apply the concept of physics to solve some of the hidden problems in natural science
- Able to identify the application of the physical concept in the otherbranches of science and scientific research

9. Structure of the Program in B.Sc. (Honors) Physics

B.Sc. Physics							
Programme Structure							
1st Semester							
Sl.No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	PHY012C101	Mechanics and properties of Matter	4	1	0	5	5
2	PHY012C102	Mathematical Physics I	4	1	0	5	5
3	PHY012C103	Modern Physics	4	1	0	5	5
4	PHY012C114	Physics (H) Lab - I	0	0	3	3	6
Ability Enhancement Compulsory Courses (AECC)							
5	CEN982A101	Communicative English – I	1	0	0	1	1
6	BHS982A104	Behavioral Science-I	1	0	0	1	1
Generic Elective							
7	MAT012G101	Mathematics - I	3	0	0	3	3
8	CHY012G101 / STA012G101	Chemistry-I / Statistics-I **(Anyone)**	2	0	0	2	2
9	CHY012G112 / STA012G112	Chemistry-LAB / Statistics-LAB **(Anyone)**	0	0	1	1	2
			Total Credit = 26				
2ndSemester							
Sl.No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects							
1	PHY012C201	Wave, Oscillation and Ray Optics	4	1	0	5	5
2	PHY012C202	Mathematical Physics-II	4	1	0	5	5
3	PHY012C203	Atomic and Molecular Spectroscopy	4	1	0	5	5
4	PHY012C214	Physics (H) Lab - II	0	0	3	3	6
Ability Enhancement Compulsory Courses (AECC)							
5	CEN982A201	Communicative English – II	1	0	0	1	1
6	BHS982A204	Behavioral Science-II	1	0	0	1	1
Generic Elective							
7	MAT012G201	Mathematics - II	3	0	0	3	3
8	CHY012G201 / STA012G201	Chemistry-II / Statistics-II **(Anyone)**	3	0	0	3	3
			Total Credit = 26				
3rd Semester							

Sl.No.	Subject Code	Names of subjects	L	T	P	C	TCP
Core Subjects							
1	PHY012C301	Heat and Thermodynamics	4	1	0	5	5
2	PHY012C302	Mathematical Physics III	4	1	0	5	5
3	PHY012C313	Physics (H) Lab - III	0	0	3	3	6
Ability Enhancement Compulsory Courses (AECC)							
4	CEN982A301	Communicative English – III	1	0	0	1	1
5	EVS982A303	Environmental Science	2	0	0	2	2
Ability Enhancement Elective Courses (Skill Based) AEEC/SEC-1 (3rd Semester) (Choose anyone)							
6	ILD9925303	ILD-1	2	0	0	2	2
7	FLG9925302	FRENCH-1	2	0	0	2	2
8		C++	1	0	1	2	3
9		Any other courses offered by other schools of RGU and opted by Student	2	0	0	2	2
Generic Elective							
10	MAT012G301	Mathematics - III	3	0	0	3	3
11	CHY012G301 / STA012G301	Chemistry-III / Statistics-III **(Anyone)**	2	0	0	2	2
12	CHY012G312 / STA012G312	Chemistry-LAB / Statistics-LAB **(Anyone)**	0	0	1	1	2
			Total Credit = 24				

4th Semester

Sl.No.	Subject Code	Names of subjects	L	T	P	C	TCP
Core Subjects							
1	PHY012C401	Electricity and Magnetism	4	1	0	5	5
2	PHY012C402	Mathematical Physics-IV	4	1	0	5	5
3	PHY012C413	Physics (H) Lab - IV	0	0	3	3	6
Ability Enhancement Compulsory Courses (AECC)							
4	CEN982A401	Communicative English – IV	1	0	0	1	1
Ability Enhancement Elective Courses (AEEC) (Skill Based) AEEC/SEC-1 (4th Semester) (Choose anyone)							
5	ILD9925403	ILD-2	2	0	0	2	2
6	FLG9925402	FRENCH-2	2	0	0	2	2
7		LATEX	1	0	1	2	3
9		Any other courses offered by other schools of RGU and opted by Student	2	0	0	2	2
Generic Elective							
10	MAT012G401	Mathematics - IV	3	0	0	3	3

11	CHY012G401 / STA012G401	Chemistry-IV / Statistics-IV **(Anyone)**	3	0	0	3	3
			Total Credit = 22				

5th Semester

Sl.No.	Subject Code	Names of subjects	L	T	P	C	TCP
		Core Subjects					
1	PHY012C501	Classical Mechanics	4	1	0	5	5
2	PHY012C502	Wave Optics	4	1	0	5	5
3	PHY012C533	Graduate Seminar	0	0	0	5	5
		Ability Enhancement Compulsory Courses (AECC)					
4	CEN982A501	Communicative English – V	1	0	0	1	1
		Elective: Discipline Specific (DSE) Subjects (Any 2)					
5	PHY012D501	Laser Physics	4	1	0	5	5
6	PHY012D502	Solid State Physics	4	1	0	5	5
7	PHY012D503	Nuclear Physics	4	1	0	5	5
			Total Credit = 26				

6th Semester

Sl.No.	Subject Code	Names of subjects	L	T	P	C	TCP
		Core Subjects					
1	PHY012C601	Quantum Mechanics	4	1	0	5	5
2	PHY012C602	Electrodynamics	4	1	0	5	5
		Ability Enhancement Compulsory Courses (AECC)					
3	CEN982A601	Communicative English – VI	1	0	0	1	1
		Elective: Discipline Specific (DSE) Subjects (Choose any one from 4 and 5) + Project					
4	PHY012D601	Statistical Mechanics	4	1	0	5	5
5	PHY012D602	Theory of Relativity	4	1	0	5	5
6	PHY012D623	Literature survey / Project	0	0	0	6	6
			Total Credit = 22				

Elective: Generic (Physics)

Sl. No.	Subject Code		L	T	P	C	TCP
1	PHY012G101	Mathematical Physics, Mechanics and Properties of Matter and Ultrasonic waves	3	0	0	3	3
2	PHY012G201	Electricity and Magnetism	2	0	0	2	2
	PHY012G212	General Physics Lab-I	0	0	2	1	1
3	PHY012G301	Optics and Atomic Physics	3	0	0	3	3
4	PHY012G401	Electronics and Nuclear Physics	2	0	0	2	2
	PHY012G412	General Physics Lab-II	1	0	0	1	1

Summary of Credits

Semester	Credit
Sem-I	26
Sem-II	26
Sem-III	24
Sem-IV	22
Sem-V	26
Sem-VI	22
TOTAL	**146**

Scheme of Evaluation

Theory Papers (T):

- **Continuous Evaluation: 15%** (Assignment, Class Test, Viva, Seminar, Quiz: AnyThree)
- **Mid-term examination:**10%
- **Attendance:5%**
- **End Term Examination:70%**

Practical Papers (P):

- **Continuous Evaluation: 25%** (Skill Test, lab copy, viva, lab involvement: AnyThree)
- **Attendance: 5**%
- **End term examination:** 70%

Combined Theory & Practical Papers (TP):

- **Continuous Evaluation: 15%** (Assignment. Class Test, Lab Experiment, Lab Copy, Viva: AnyThree)
- **Mid-term examination:**10%
- **Attendance:5%**
- **End term examination:** 70%

1st Semester Syllabus

SYLLABUS (1st SEMESTER)

Paper I/Subject Name: Mechanics and Properties of Matter **Subject Code: PHY012C101**

L-T-P-C: 4-1-0-5 **Credit Units: 5** **Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To understand the basics of Dynamics, Classical mechanics & Properties of matter	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Moment of Inertia, Gravitational potential and intensity and pendulum. 2. Elasticity, Surface tension and Viscosity. 3. Fundamentals of Dynamics 4. Inertial and non-inertial frame of reference, centrifugalforceandCoriolisforce and Collision	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz: Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	Moment of Inertia. Calculation of Moment of Inertia for Rectangular, Cylindrical, and Spherical Bodies. Gravitational potential and intensity, calculation of gravitational potential and intensity due to thin spherical shell, Compoundpendulum, measurement of 'g' by Kater's pendulum.	**9**
II.	Elasticity: Different type of elastic constants and relation among them. Energy in a strained body, torsion of a rod, bending of beam, bending moment, cantilever, depression of a cantilever considering the weight of the beam. Surface tension: Surface tension, relation between surface tension and surface energy, excess pressure inside a curved liquid surface. Determination of surface tensionofabubble.Viscosity:Poiseullie'sequationforflowofaliquidthrough narrow tube. Determination of viscosity by rotating viscometer.	**11**
III.	Fundamentals of Dynamics: Dynamics of a System of Particles. Centre of Mass. Conservation of Momentum. Idea of Conservation of Momentum from Newton's Third Law.Impulse. Work-energy theorem, integral of the equation of motion, potential energy, conservative force as the negative, general law of conservation of energy. Torque, Conservation of Angular Momentum.	**11**
IV.	Inertial and non-inertial frame of reference. Transformation equation of coordinate, velocity, acceleration in rotating frame of reference. Transformation equation of forceinnon-inertialframes.Fictitiousforces,centrifugalforceandCoriolisforce. Effect of fictitious force on the earth, Collision: elastic and inelastic collision.	**9**
Total		**40**

Text:

1. Elements and properties of matter - Mathur D.S., S. Chand Publication, 11th Edition (2016).

Reference Books:

1. Purcell E.M. *Mechanics*, (Ed): Vol. I, Mc Graw Hill. Berkely Physics Course,2nd edition(2017).
2. Feynmam R.P. et. al., *The Feynmam Lectures in Physics*, Vol.I,B.I. Publication.(2012).

SYLLABUS (1st SEMESTER)

Paper II/Subject Name: Mathematical Physics-I **Subject Code: PHY012C102**

L-T-P-C : 4-1-0-5 **Credit Units: 5** **Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To understand the application of mathematics in Physics and solve the physical problem	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. The Coordinate System 2. Vectors, Ordinary derivatives of vectors 3. Concept of gradient 4. Matrices 5. Special functions: Beta and Gamma functions and Fourier Series	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz: Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	The Coordinate System: Orthogonal and non-orthogonal, Right-handed and Left-Handed Cartesian system, Necessity for curvilinear co-ordinate system. Polar, cylindrical, and general curvilinear coordinate system. Length, area, and volume elements in all these systems.	**10**
II.	Vectors: Vectors, Scalars, Vector algebra, Product rules, Vector fields, scalar fields. Vector triple product, polar and axial vectors, and their examples from Physics. Vectorial equation of straight line, plane, and circle. Base vector, vector transformations. Ordinary derivatives of vectors, space curves, Partial derivatives of vectors, Differentials of vectors, Concept of gradient, divergence, and curl. Application of above concept to simple physical phenomena.	**10**
III.	Matrices: Addition law of matrices, matrix multiplication, properties of matrices, special square matrices, inverse of matrices, Elementary transformation of matrices – similarity, orthogonal and unitary transformation. Eigen value, Eigen vector. Solution of simultaneous linear equations. Diagonalization ofmatrix.	**10**
IV.	Special functions: Beta and Gamma functions, relation between them, recurrence relation for gamma function; Fourier Series: Fourier's Theorem and Fourier series, application of Fourier's theorem to square wave and saw tooth wave.	**10**
Total		**40**

Text:

1. *Mathematical Physics* by: Das H.K. S. Chand publishing 8th edition(2018).

Reference Books:

2. Dyke P P*An Introduction to Laplace Transform and Fourier Series,* Springer, 2nd edition (2014).
3. Rajput and Yogprakash*Mathematical Physics,* Pragati Prakashan, Meerut(2014).

SYLLABUS (1st SEMESTER)

Paper III/Subject Name: Modern Physics **Subject Code: PHY012C103**

L-T-P-C: 4-1-0-5 **Credit Units: 5** **Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To familiarize the students with basic concepts of modern physics	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Special theory of relativity, Quantum theory 2. Nuclear structure, Radioactive decay and Elementary particles, 3. Crystal structure and defects, Semiconductor and Superconductivity 4. Laser and Optical fibers	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	Special theory of relativity: inertial frame of reference, Galilean transformations, velocity of light, Michelson-Morley experiment, Lorentz transformations, consequences of Lorentz transformations. Quantum theory: inadequacy of classical mechanics, the Frank-Hertz experiment, Spatial(space) quantization, the uncertainty principle, application of uncertainty principle.	**10**
II.	Nuclear structure: Nuclear composition, nuclear properties, stable nuclei, binding energy; Nuclear transformation: Radioactive decay, half-life, alpha, beta and gamma decay, nuclear fission, and fusion; Elementary particles: interactions and particles, types, concept of quark.	**8**
III.	Crystal structure and defects: space lattice and crystal structure, Bravis lattice, unit cell, atomic radius, density of crystal, coordinates number, Millar indices and crystal planes. Crystal bonding: ionic, covalent, metallic, molecular, or van-Waal's bonding, hydrogen bonding Semiconductor: Atomic structure and energy level, energy bands, conductor, semi-conductors and insulators, Fermi-Level, intrinsic and extrinsic semiconductor. Superconductivity: Experimental features of superconductivity, special features of superconductor, BCS theory of superconductivity, cooper Pairs	**12**
IV.	Laser: Introduction, Important properties of Laser, characteristics of laser, principle of Laser, working mechanism of three and four level laser, applications ofLaser. Optical fibres: total internal reflection, optical fibre, classification of optical fibres, advantages of optical fibre.	**10**
Total		**40**

Text:

1. *Concept of Modern Physics*; Beiser A., McGraw Hill Education; 6th Ed., 2015, NewDelhi.
2. *Modern Physics*; MurugeshanR.andSivaprasath K., S Chand, 18th Ed., 2016, NewDelhi.

Reference Books:

1. Krane K. S.; *Modern Physics*, John Wiley & Sons, 3rd Ed.,2012.
2. Kakani S.L. and Kakani S.*; Modern Physics*, Viva Books Pvt. 1st Ed. 2007, NewDelhi.

SYLLABUS (1st SEMESTER)

Paper IV/Subject Name: Physics (H) Lab-I **Subject Code: PHY012C114**

L-T-P-C : 0-0-3-3 **Credit Units: 3** **Scheme of Evaluation: P**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To make the students practically interested in the subject	1. Demonstration 2. Experimentation 3. Correction	On completion of this course students will be able to gain understanding of the following: 1. Determination of Modulus of elasticity. 2. Determination of "g" by Kater's Pendulum. 3. Identification of different series spectra. 4. Frank and Hertzexperiment	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Skill test, lab copy, viva, lab involvement: Any Three:25, Attendance: 5)

List of experiments:

1. To determine the Moment of Inertia of a given solid about its own axis by usingM.I.Table
2. To determine the Young's Modulus of a Wire using Searle'sApparatus
3. Determination of Rigidity of Modulus of the material of the given rod by Staticalmethod.
4. To determine g by Kater'sPendulum.
5. Determination of coefficient of Viscosity of water by Capillary FlowMethod
6. To determine surface tension capillary tubemethod.
7. To determine the Young's Modulus of the material of the given rod by bending ofbeam.
8. Identification of different series spectra of sodium atom and measurement of the wavelength using CDS.
9. Measurement of excitation and ionization potential using Frank and Hertzexperiment.

Text

1. *B.Sc Practical Physics* C.L. Arora S. Chand 20th edition (2010).

References:

2. Mazumdar K.G. and Ghosh B.*A Textbook on Practical Physics* Sreedhar Publishers16th edition(2012).

2nd Semester Syllabus

SYLLABUS (2nd SEMESTER)

Paper I/Subject Name Wave, Oscillation and Ray Optics		Subject Code: PHY012C201
L-T-P-C: 4-1-0-5	Credit Units: 5	Scheme of Evaluation: T

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To make the students understand Optics and its applications in present day world	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Geometrical optics, Fermat's principles, and lens maker's formula 2. Defects of image 3. Simple harmonic motion 4. plane progressive wave motion in one and three dimension and Vibration of strings	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz: Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	Geometrical optics: Fermat's principles. Deduction of laws of reflection and refraction using Fermat's principle for plane and curved surfaces. Deduction of lens maker's formula. Thick lens: cardinal points (deduction not necessary).	**10**
II.	Defects of image: Monochromatic aberration and chromatic aberration, Different types of monochromatic aberration. Chromatic aberration and its correction, Achromatic combination of lens & prism.	**10**
III.	Simple harmonic motion: Simple harmonic oscillation - differential equation and its solution. Instantaneous and average total energy. Superposition of two simple harmonic motions, Damped and forced vibrations. Sharpness of resonance.	**10**
IV.	Wave: Linear equation of plane progressive wave motion in one and three dimension, Instantaneous and average energy of one-dimensional wave, Propagation in dispersive medium –Group and phase velocity Vibration of strings: Wave equation in linear approximation, Eigen values and eigen functions of pluck and stuck string.	**10**
Total		**40**

Text:

1. *Fundamentals of Optics*- Jenkins F. A. and White H. E.: McGraw Hill(2017).

Reference Books:

1. GhatakA.K.:*Physical Optics(2017)*
2. Khandelwal D.P., :*Optics and Atomic Physics*: Himalaya Publishing House(2015).

SYLLABUS (2nd SEMESTER)

Paper II/Subject Name: Mathematical Physics-II		**Subject Code: PHY012C202**
L-T-P-C: 4-1-0-5	**Credit Units: 5**	**Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To make the students understand the phenomena of physics using the mathematical concept	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Integration of vectors, Green's theorem and Stokes' theorem 2. Differential Equations 3. Probability theory 4. Complex Variable, Euler's formula	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz: Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	Integration of vectors Ordinary integration of vectors. Line integral, surface integral and volume integrals and their applications to simple problems. Green's theorem in the plane Gauss's divergence theorem, Stokes' theorem and their applications.	**9**
II.	Differential Equations: Second order linear differential equations, series method of solutions (Frobenius), Legendre's differential equations, Legendre's polynomial, Hermite's differential equations, Hermite's polynomial.	**11**
III.	Probability theory Mutually exclusive events, theorem of total probability, compound events and theorem of compound probability. Probability distributions -Gaussian distribution, mean and standarddeviation.	**9**
IV.	Complex Variable Algebraic operation, Argand diagram, vector representation, complex conjugate, Euler's formula, De-Moiver's theorem. Analytic function of a complex variable, Derivative of F(z) and its analyticity, contour integrals.	**11**
Total		**40**

Text:

1. *Mathematical Physics* by: Das H.K. S. Chand publishing (2018).

Reference Books:

1. Rajput and Yogprakash Mathematical *Physics* Pragati Prakashan, Meerut(2017).
2. Arfken and Weber *Mathematical methods for physicists*, Academic Press(2017).
3. Potter M.C., Goldberg J. *Mathematical Methods* Prentice Hall, India(1999).

SYLLABUS (2nd SEMESTER)

PaperIII/Subject Name: Atomic and Molecular Spectroscopy		Subject Code: PHY012C203
L-T-P-C: 4-1-0-5	Credit Units: 5	Scheme of Evaluation: T

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To create the idea of atomic & molecular spectra and study the effects that are due to spectroscopy.	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Thomson Model, Bohr atom model 2. Somerfield model and vector atom model 3. Spectra of alkali elements and X-ray spectra 4. Molecular Spectra and Electronic spectra	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz: Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	Thomson Model, Rutherford alpha particle finding experiment and nuclear atom model. Limitation of the model. Bohr atom model. Hydrogen like atom spectra. Correspondence principle.	**9**
II.	Somerfield model (elliptical orbit and relativistic correction) Vector atom model (Space quantization and spinning electron). Quantum number associated with vector atom model. Spin – Orbit interaction, Spectral term, Fine structure of hydrogen atom, Stern- Gerlach experiment.	**10**
III.	Spectra of alkali elements: general features, spectral series, spectra of sodium atom, selection and intensity rules. LS-jj coupling, spectra of alkaline earth elements: general features, singlet, triplet series. X-ray spectra: continuous spectra, Duane-Hunt law, characteristics lines, Mosley law, Absorption spectra, fine structure.	**10**
IV.	Molecular Spectra The Born-Oppenheimer approximation, rotational spectra, rigid diatomic molecule, rotational energy of the diatomic molecule, simple harmonic oscillator, and Anharmonic oscillator. Electronic spectra: Franck-Condon principle, Vibrational coarse structure (sequence and progressive)	**11**
Total		**40**

Text:

1. *Fundamentals of molecular spectroscopy* – Colin N. Banwell and Elaine M. Mccash: McGraw-Hill College(2016).

Reference Books:

1. Beiser.A :*Concept of Modern Physics*: Publisher: McGraw Hill Education(2009).
2. White :*Introduction to Atomic spectra* ; publisher Mc graw-hill book company(2016).
3. KedarnathRamnath:*Atomic and MoleculerSpectra* :Laser: publisher ,Raj Kumar,(2012).
4. Gupta. S.L., V.Kumar,R.C.Sharma;*Elements of Spectroscopy* ; Pragati Prakashan.(2016).
5. . RajamJ.B;*Atomic physics* ; Publisher, S. Chand(2010)

SYLLABUS (2nd SEMESTER)

Paper IV/Subject Name: Physics (H) Lab II		**Subject Code: PHY012C214**
L-T-P-C: 0-0-3-3	**Credit Units: 3**	**Scheme of Evaluation: P**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To make the students understand Optics and its applications in present day world.	1. Demonstration 2. Experimentation 3. Correction	On completion of this course students will be able to gain understanding of the following: 1. Determination of Power of given lenses, Refractive Index. 2. Determination of the density of the material and frequency of a tuning fork of Melde's experiment.	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Skill test, lab copy, viva, lab involvement: Any Three:25, Attendance: 5)

List of Experiment:

1. Determination of refractive index of a transparent liquid by using a travellingmicroscope.
2. Determination of Power of given lenses using an optical bench (i) Concave lens (ii) Convexlens
3. Determination of Refractive Index of the material of a prism by spectrometer using minimum deviation method.
4. To find the density of the material of a wire by employingsonometer.
5. Determination of wavelength of light/no. of rulings per cm using transmission grating spectramethod.
6. To determine the radius of curvature of the lower surface of a plano-convex lens by using Newtons ring method.
7. To determine the frequency of a tuning fork of Melde'sexperiment.
8. Determination of magnifying power of atelescope.

Text:

1.*B. Sc Practical Physics* C.L. Arora S. Chand 20th edition, 2010

References:

1.Mazumdar K.G. and Ghosh B.*A Textbook on Practical Physics* Sreedhar Publishers16th edition ,2012

3rd Semester Syllabus

SYLLABUS (3rd SEMESTER)

Paper I/Subject Name: Heat and Thermodynamics		Subject Code: PHY012C301
L-T-P-C: 4-1-0-5	Credit Units: 5	Scheme of Evaluation: T

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To know the fundamentals of heat and to understand the concepts involved in transmission of heat, principle and laws of thermodynamics and entropy	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Newton's law of cooling, Specific heat of a gas, Debye's theory of specific heat 2. Transmission of heat, Wein's law, Raleigh Jean's Law, Stefan's law 3. Laws of thermodynamics, Carnot's engine 4. Concept of entropy, Maxwell's thermodynamics relations and applications	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	Introduction to heat Basic Definitions: Newton's law of cooling, Specific heat of a liquid calendar and Barne's continuous flow method, Two specific heats of a gas , Specific heat of a gas at constant volume by Jolly's differential steam calorimeter , Specific heat of a gas at constant pressure by Regnault's method, Dulong and Petit'slaw, Einstein's theory of specific heat - Debye's theory of specific heat	10
II.	Transmission of heat: Conduction – Coefficient of the thermal conductivity – Rectilinear flow of heat along a metal bar ,Kirchhoff's law of heat exchange, Prevost theory of heat exchange, Conduction , Black body Radiation, Wein's law, Raleigh Jean's Law, Stefan's law , Mathematical derivation of Stefan's law. Derivation of Newton's law of cooling from Stefan's law.	10
III.	Laws of thermodynamics: First law of thermodynamics, Isothermal and Adiabatic process, Isochoric process, Isobaric process, Gas equation during an adiabatic process, Work done during an adiabatic expansion of gas, Equation of an adiabatic curve. Second law of thermodynamics, Concept of Carnot's engine, Working efficiency of Carnot's engine, Carnot's refrigerator, Carnot's Theorem, and its significance.	10
IV.	Concept of entropy: Third law of thermodynamics, Concept of Entropy, Temperature entropy diagram, entropy of perfect gas ,Entropy Change in entropy in a reversible process and irreversible process, Entropy of a perfect gas – increase of entropyinanyirreversibleprocess,Thermodynamicsfunctions,Maxwell's thermodynamics relations and applications – Joule Kelvin Coefficient.	10
Total		**40**

Text:

1. *Heat and Thermodynamics*, Richard H Dittman and Zemansky MW, 3rd Special Edition, McGraw Hill,2008.
2. *Heat and Thermodynamics*, Brijlal, N. Subrahmanyam, Revised Edition, S. Chand and Company,2010.

References:

1. D.S. Mathur, *Heat and Thermodynamics*, S. Chand and Company,2008
2. Kittel C and Kroemer H, *Thermal Physics*, W. H. Freeman, New York,2014.
3. Stephen Blundell and Katherine M. Blundell, *Concepts in Thermal Physics*,Oxford University Press,2006.

SYLLABUS (3rd SEMESTER)

Paper I/Subject Name: Mathematical Physics-III		Subject Code: PHY012C302
L-T-P-C; 4-1-0-5	Credit Units: 5	Scheme of Evaluation: T

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To make the students understand the application of mathematics in Physics and solve the physical problem	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Complex variables, Cauchy-Rieman conditions 2. Finite difference and numerical methods 3. Solutions to partial differential equations 4. Laguerre Polynomials	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	Complex variables, concepts of neighbor-hood, limit and continuity, analytical function, Cauchy-Rieman conditions and their applications. Contour integral theorem	**10**
II.	Finite difference and numerical methods The forward difference operator, Backward difference operator, Interpolation, Extrapolation, Newton-Gregory Formulae for equal interval, Lagrange formula for unequal interval.	**10**
III	Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and Spherical symmetry.	**10**
IV.	Laguerre Polynomials : Rodrigues' Formulae, Generating Functions, Recurrence Relations, Orthogonality. Bessel Functions: First and Second Kind, Generating Function, Recurrence Formulas, Zeros of Bessel Functions and Orthogonality.	**10**
Total		**40**

Text:

1. Mathematical Physics by: Das H.K. S. Chand publishing, 2018.

Reference Books:

1. Dyke P P, *An Introduction to Laplace Transform and Fourier Series* Springer,2014.
2. Rajput and Yogprakash, Mathematical *Physics* Pragati Prakashan, Meerut,2017.
3. Arfken and Weber, *Mathematical methods for physicists*, Academic Press,2012.
4. Potter M.C., Goldberg J. *Mathematical Methods* Prentice Hall, India, 2000.

SYLLABUS (3rd SEMESTER)

Paper I/Subject Name: Physics (H) Lab III		**Subject Code: PHY012C313**
L-T-P-C : 0-0-3-3	**Credit Units: 3**	**Scheme of Evaluation: P**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To know the basic applications of different devices in Physics	1. Demonstration 2. Experimentation 3. Correction	On completion of this course students will be able to gain understanding of the following: 2. Coefficients of expansion of several metals, the static characteristics curves of a PN junction diode 3. Law of Malus, use of Fresnel Biprism 4. Refractive index of a liquid 5. Bipolar Junction Transistor, response curve of a Parallel LCR circuit	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Skill test, lab copy, viva, lab involvement: Any Three:25, Attendance: 5)

List of experiments:

1. To measure the coefficients of expansion of severalmetals.
2. To draw the static characteristics curves of a PN junction diode in forward bias and hence determine its DC and AC resistances for a givencurrent
3. To verify the Law of Malus for Plane PolarizedLight.
4. To use a prism shaped double refracting crystal to determine the refractive indices of the material corresponding to ordinary and extra-ordinaryrays.
5. To determine wavelength of sodium light using FresnelBiprism.
6. To determine the e.m. f of a cell using a cell of known e.m.f with the help of potentiometer.
7. To measure the Self Inductance of a Coil by Anderson's Bridgemethod.
8. To find the refractive index of a liquid with the help of a convex lens and a planemirror
9. To study input and output characteristics of a npn Bipolar Junction Transistor (BJT) in Common-emitterconfiguration.
10. To study the response curve of a Parallel LCR circuit and determine its (a) Anti-Resonant Frequency and (b) Quality FactorQ.

Texts:

1. Experimental Physics Wersnop and Flint(2017)
2. A Text Book on Practical Physics by K.G. mazumdar and B. Ghosh, Sreedhar Publishers 16thedition (2012)
3. P. B. Zbar and A. P. Malvino, Basic Electronics: a text-lab manual, Tata McGraw Hill(1994).
4. A. Lipson, S G Lipson, H Lipson, Optical Physics, Cambridge University Press;4th(2010)

4thSemester Syllabus

SYLLABUS (4th SEMESTER)

Paper I/Subject Name: Electricity and Magnetism		Subject Code: PHY012C401
L-T-P-C :4-1-0-5	Credit Units: 5	Scheme of Evaluation: T

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To establish the first grounding in electromagnetism in preparation for more advanced courses.	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Norton theorem, Thevenin theorem, etc, 2. Electric field and potential for different cases along with Gauss law 3. Magnetic field, magnetic dipole, Bio-Savart's law, Ampere's circuital law, 4. Gauss' law of magnetism, Magnetization vector, Magnetic intensity, B-H curve etc.	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz: Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I	Network theorem. Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem and Maximum Power Transfer theorem.	7
II	Electric Field and Lines. Electric Flux. Gauss's law. Gauss's law in Differential form. Applications of Gauss's Law. Electric Potential Difference and Electric Potential. Conservative Nature of Electrostatic Field. Relation between **E** and V. Electrostatic Potential Energy of a System of Charges. Potential and Electric Field of a Dipole, a Charged Wire and a Charged Disc. Force and Torque on a Dipole.	11
III	Magnetic Effect of Currents: - Magnetic Field **B**. Magnetic Force between Current Elements and Definition of **B.** Magnetic Flux. Biot-Savart's Law: **B** due to a Straight Current Carrying Conductor and Current Loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital law (Integral and Differential Forms): B due to (1) a Solenoid and (2) a Toroid. Properties of **B.** Curl and Divergence of**B**. Vector Potential.	11
IV	Magnetism of Matter: - Gauss's law of magnetism (Integral and Differential Forms). Magnetization current. Relative Permeability of a Material. Magnetic Susceptibility. Magnetization Vector (**M**). Magnetic Intensity (**H**). Relation between **B**, **M** and **H**. Stored Magnetic Energy in Matter. Magnetic Circuit. B-H Curve and Energy Loss in Hysteresis. Faraday's law (Differential and Integral forms). Lenz's Law. Self and Mutual Induction. Energy stored in a Magnetic Field.	11
Total		**40**

Text:

1. *Electricity and Magnetism*, by D C Tayal (Himalaya Publishing House, 4th revised edition, 2014)

Reference Books:

1. Edward M. P. *Electricity and Magnetism* (McGraw-Hill Education,1991)
2. Fewkes J.W. &Yarwood J, *Electricity and Magnetism* Vol. I (Oxford Univ. Press,1991)
3. Griffiths D.J., *Introduction to Electrodynamics*, Pearson Education India Learning Pvt. Limited; 4th edition (2015).

SYLLABUS (4th SEMESTER)

Paper I/Subject Name: Mathematical Physics-IV		**Subject Code: PHY012C402**
L-T-P-C: 4-1-0-5	**Credit Units: 5**	**Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To make the students understand the application of mathematics in Physics and solve the physical problem	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Wave equations in 1D and 2D with applications like rectangular membrane etc., 2. Different numericalintegration likeSimpson's, trapezoidal rule etc. 3. Tensors, and different properties of tensors, 4. Ordinary differential equations like Taylor's series, Euler method etc.	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz: Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics / Course content	Periods
I.	General Solution of Wave Equation in 1 Dimension. Transverse Vibrations of Stretched Strings. Oscillations of Hanging Chain. Wave Equation in 2 Dimensions. Vibrations of Rectangular and CircularMembranes.	**11**
II.	Numerical Integration Quadrature formula, Trapezoidal rule, Simpson's 1/3 rd rule, Simpson's 3/8 rule.	**8**
III.	Transformation of coordinates, tensorial character of physical quantities, symmetric and antisymmetric tensors, rules for combination of tensors, additions, subtractions, outer multiplications, contractions and inner multiplications, differentiation of tensors and kronekar Delta.	**13**
IV.	Numerical solution of ordinary differential equation, Taylor series method, Euler method, Runge- kutta methods.	**8**
Total		**40**

Text:

1. *Mathematical Physics* by: Das H.K. S. Chand publishing, 8th edition, 2018.

Reference Books:

1. Dyke P P*An Introduction to Laplace Transform and Fourier Series* Springer,2014.
2. Rajput and Yogprakash*Mathematical Physics* Pragati Prakashan, Meerut,2017.
3. Arfken and Weber *Mathematical methods for physicists*, Academic Press,2012.
4. Potter M.C., Goldberg J. *Mathematical Methods* Prentice Hall, India,2000.

SYLLABUS (4th SEMESTER)

Paper I/Subject Name: Physics (H) Lab IV		**Subject Code: PHY012C313**
L-T-P-C – 0-0-3-3	**Credit Units: 3**	**Scheme of Evaluation: P**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To know the basic applications of different devices in Physics	1. Demonstration 2. Experimentation 3. Correction	On completion of this course students will be able to gain understanding of the following: 2. Determination of spring constant, thermal conductivity of Copper, mechanical equivalent of heat 3. Absorption spectra of Iodine molecule 4. Babinet Compensator 5. Zener Diode 6. Oscilloscope and Multimeter 7. LCR circuit 8. Zeeman Effect	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Skill test, lab copy, viva, lab involvement: Any three:25, Attendance: 5)

List of experiments:

1. Determination of spring constant using static and dynamicmethod.
2. Measure the thermal conductivity of Copper using the Searle's barmethod
3. To measure the mechanical equivalent of heat by an electricalmethod.
4. To study absorption spectra of Iodine molecule and to determine its dissociation energy using spectrometer.
5. Analysis of elliptically polarized light using BabinetCompensator.
6. To determine the (a) Charge Sensitivity and (b) Current Sensitivity of aB.G.
7. To study the Forward and Reverse characteristics of a Zener Diode and to study its use as a VoltageRegulator.
8. To study the RC characteristic using Oscilloscope andMultimeter
9. To study the response curve of a Series LCR circuit and determine its (a) Resonant Frequency, (b) Impedance at Resonance and (c) Quality Factor Q, and (d) Band Width.
10. Study of Zeeman Effect and determination of e/m ofelectron.

Texts:

1. Experimental Physics Wersnop and Flint (2017)
2. A Textbook on Practical Physics by K.G. Mazumdar and B. Ghosh, Sreedhar Publishers(2012)
3. P. B. Zbar and A. P. Malvino, Basic Electronics: a text-lab manual, Tata McGraw Hill(1994).
4. A. Lipson, S G Lipson, H Lipson, Optical Physics, Cambridge University Press;4th(2010)

5th Semester Syllabus

SYLLABUS (5th SEMESTER)

Paper I/Subject Name: Classical Mechanics **Subject Code: PHY012C501**

L-T-P-C: 4-1-0-5 **Credit Units: 5** **Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To understand the basics concepts of classical mechanics	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 2. Linear and angular momentum, laboratory and center of mass system, 3. Central force motion, Kepler's laws of planetary motion 4. D' Alembert's principle, Lagrange's equation of motion 5. Hamilton's principle, Lagrange's equation from Hamilton's principle, Poisson brackets etc.	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	Mechanics of a particle and a system of particles; linear uniformities of space and conservation of linear momentum, rotational invariance of space and conservation of angular momentum, homogeneity of time and conservation of energy; laboratory and centre of masssystems	**10**
II.	Central force motion and general properties, two body motion as one body problem, energy and momentum as constants of motion in central force, energy diagram and nature of orbits; motion in an inverse square law force field; Kepler's laws of planetary motion.	**10**
III.	Constraints, generalized co-ordinates; principle of virtual work, D' Alembert's principle and Lagrange's equations of motion; applications of Lagrangian formulations to atwood machine, simple pendulum, bead sliding on rotating wire, compound pendulum, linear harmonic oscillator	**10**
IV	Hamilton's principle, shortest distance between two points; Lagrange's equations from Hamilton's principle; Hamilton's canonical equations of motion; applications of Hamilton's equations to simple problems; Poisson brackets.	**10**
TOTAL		**40**

Text Book:

1. *Classical Mechanics*; Goldstein H., Narosa Publishing House, 3rdEd., New Delhi,2011.

Reference Books:

1. Rana &Yoag, *Classical Mechanics*, Tata McGraw-Hill Publishing Company Limited, 1st Ed., New Delhi,2017.
2. Upadhaya J. C, *Classical Mechanics*, Himalaya Publishing House, 3rd Ed., Mumbai,2017

SYLLABUS (5th SEMESTER)

Paper II/Subject Name: Wave Optics **Subject Code: PHY012C502**

L-T-P-C: 4-1-0-5 **Credit Units: 5** **Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To introduce students with the basic knowledge of the wave nature of light	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Newton's corpuscular theory, reflection and refraction of plane and spherical wave front, convex and concave lens, 2. Fresnel's biprism, Newton's ring, Michelson interferometer, zone plate, 3. Fresnel and Fraunhofer diffraction, dispersive power of a grating etc., 4. Brewster's law, Malus law, Circularly and elliptically polarized light, Quarter and Half wave plate etc.	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	Newton's Corpuscular Theory, Reflection and refraction of light on Corpuscular Theory, Wave motion, Equation of Simple Harmonic wave, Composition of two/number of Simple Harmonic Motion in a straight line, Huygen's Principle, Reflection and refraction of a Plane Wave front at a Plane and Spherical Surface, Reflection and refraction of a Spherical Wave front at a Plane and Spherical Surface, Refraction through a Convex and Concave Lens.	**10**
II.	Interference: Introduction and its application in Thin Films, Fresnel's mirrors and Biprism, Lloyd's single mirror, Colours of Thin Films, Newton's ring, Michelson Interferometer, Fabry-Perot Interferometer, Brewster's Fringes, Brief introduction to different types of Refractometer (Qualitative).	**10**
III.	Zone plate, Fresnel and Fraunhofer Diffraction, Diffraction due to a Narrow Wire, Cornu's Spiral, Maxima and Minima in Diffraction pattern, Fraunhofer Diffraction at a single slit, double slit and circular aperture, Interference and Diffraction, Fraunhofer Diffraction at N slit, Plane Diffraction Grating, Dispersive power of a Grating.	**10**
IV	Polarization, Plane of Polarization, Brewster's Law, Malus Law, Double Refraction, Principal Plane, Nicol Prism, Optic Axis in the Plane of Incidence and Inclined & parallel to the crystal surface, Elliptically and Circularly Polarized light, Quarter and Half wave plate.	**10**
TOTAL		**40**

Text Book:

1. *Fundamental of Optics*; Jenkins F.A. and White H.E.: McGraw Hill, 4t edition, 2011

Reference Books:

1. Ghatak A.K, *Optics*, 2014. McGraw Hill Education; 5th edition2017.
2. Born and Wolf, *Principles ofOptics*,7thedition ,1999.

SYLLABUS (5th SEMESTER)

Paper III/Subject Name: Graduate Seminar **Subject Code: PHY012C533**

L-T-P-C : 0-0-0-5 **Credit Units:5** **Scheme of Evaluation: T/P**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To improve the presentation skill and subject knowledge of the students	1. One to one guidance and supervision 2. Individual and Group Presentation	On completion of this course students will be expected to acquire confidence to present their research work in the future	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Class test, viva, Mid-term exam:25, Attendance : 05)

Graduate Seminar

SYLLABUS (5th SEMESTER)

Paper IV/Subject Name: Laser Physics **Subject Code: PHY012D501**

L-T-P-C: 4-1-0-5 **Credit Units: 5** **Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To develop knowledge about basic properties and working principles of laser, also provide information and introduction towards its applications	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. MASERS and LASERS, lasing action, population inversion, Einstein's A and B coefficients, basic components of lasers, 2. Q factor, solid state, semiconductor laser 3. Laser Raman spectroscopy, stokes and anti-stokes lines, 4. Nonlinear optical processes, laser cutting, optical fibers etc .	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	MASERS and LASERS; Basic features of a laser: directionality, coherence, mono-chromaticity; Spontaneous and stimulated emission; Condition for lasing action, population inversion, two level, three level and four level systems; Einstein's A and B co-efficient and their relation.	**8**
II.	Basic component of lasers: pumping sources, gain medium, laser resonator cavities: different types of laser cavity and their working principles, Cavity stability and cavity modes, Q-factor, losses in the cavity; Continuous wave vs pulsed lasers, Q-switching and mode locking of lasers (Qualitativeonly). Types of lasers: solid state lasers (Ruby lasers) and Semiconductor diode lasers. Working principles and applications of these lasers.	**12**
III.	Gaussian beam profile of laser: Intensity profile, beam width, beam waist, beam divergence and Rayleigh range. Line broadening mechanism in laser, laser holography, laser Raman spectroscopy, stokes and antismoke Raman spectroscopy, stimulated Raman scattering.	**10**
IV	Nonlinear optical processes: Self-focusing, self-phase modulation. Applications of lasers: Laser imaging, Biomedical applications: basic, laser surgery, Industrial use: Laser cutting, laser engraving. Optical communications; optical fibres, construction and working of different types of fibre, Signal attenuation, Point to point optical communication.	**10**
	TOTAL	**40**

Text Book:

1. *Laser and nonlinear optics*, B.B.Laud**,** New age international (P)limited, 3rd edition, 2011.

Reference Books:

1. Thyagarajan K, and Ghatak A., *Lasers fundamentals and applications*, Spinger, New York,ISSN-1868-4513, 2010.
2. Svelto O., *Principles of Lasers,* Polytechnic Institute of Milan and National Research Council. Milan, Italy, fifth edition(2014)
3. Boyd R.W., *Non-Linear Optics,* Elsevier, Third edition,2008.
4. Beiser A. *Concepts of Modern Physics,* 6th edition, Tata McGraw-Hill, New Delhi(2017).

SYLLABUS (5th SEMESTER)

Paper V/Subject Name: Solid State Physics		**Subject Code: PHY012D502**
L-T-P-C: 4-1-0-5	**Credit Units: 5**	**Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To develop basic concepts of matters in a solid, understand the underlying physics behind different properties of a solid	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Crystalline solid, lattice, Miller indices, X ray diffraction, 2. Drude model of free electron theory, Bloch theorem, K-P model of band theory, 3. lattice vibration, superconductivity, BCS theory, dielectric and magnetic properties of matter, B-H curveetc	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	Crystal Structure of Solids: Amorphous and Crystalline Materials; Crystal lattices, Lattice with a Basis, Lattice Translation Vectors; Unit cells: Primitive and nonpremitive unit cells, atomic packing fraction of unit cells; Miller indices, crystal planes, distance between two adjacent planes, Bragg's plane and X-ray diffraction by crystal; Crytal structuresandsymmetryofcrystals;Conceptofreciprocallatticeanditsrelationtoreallattice, Brillouin Zones.	**8**
II.	Free electron theory of metals: Drude model, Electrical Properties of Materials: electrical conductivity of metals, mean free path, thermal conductivity, Wiedemann - Franz law. Concept of fermi level and fermi distribution function; Hall effect. Elementary Band Theory of Solids; Bloch Theorem; Kronig-Penney Model; Band Gaps; Energy Band Diagram and Classification of Solids; Effective Mass of Electron; Concept of Holes, Distinction between insulators, semiconductors and conductor; Intrinsic and Extrinsic semiconductors, p- and n- type semiconductors, fermi level in semiconductors; Conductivity in Semiconductors.	**12**
III.	Lattice Vibrations and Phonons:- Linear Monoatomic and Diatomic chains; acoustical and optical phonon; Classical phonon dispersion relation; Einstein and Debye theories of specific heat of solids. Superconductivity: Introduction to super conductivity; critical temperature; Critical magnetic field; Meissner effect; Type-I and type-II superconductors, London's equation. Idea of BCS theory (No derivation): Cooper Pair and coherence length; Experimental evidence of phonons (Qualitative); Josephson effect.	**10**
IV	Dielectric Properties of Materials: Electrostatic polarization, sources of polarization; Dielectric constant, electric susceptibility. Polarizability; Classical theory of electric polarizability, Clausius Mosotti equation. Magnetic Properties of Matter: Atomic origin of magnetism and magnetic moment, Dia, Para-, Ferri- and ferromagnetic materials; Theory of magnetic domains; Curie's law, introduction to ferromagnetism and ferromagnetic domains; Concept of magnetic field and magnetization, relationship between B, H and M, Discussion of B-H Curve, hysteresis and energy Loss.	**10**
	TOTAL	**40**

Text Book:

1. *Introduction to Solid State Physics*, Charles Kittel, 7th Edition, John Wiley and Sons,Inc., 2012.

Reference Books:

2. Dekkar A. J., *Solid State Physics*, Macmillan India Limited,2008.
3. Blackmore J. S., *Solid State Physics*, Cambridge University Press,Cambridge, 2012.
4. Ascroft N. W. and Mermin N. D., *Solid State Physics*, Harcourt Asia, Singapore,2003.
5. Omar M. A., *Elementary solid state physics: principles and applications*, Pearson Education,1999.

SYLLABUS (5th SEMESTER)

Paper VI/Subject Name: Nuclear Physics		**Subject Code: PHY012D503**
L-T-P-C: 4-1-0-5	**Credit Units: 5**	**Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To establish the grounding in Nuclear Physics	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Nuclear structure, a.m.u., binding energy, 2. Q value of nuclear reactions, nuclear fission, fusion, nuclear forces, 3. Semi empirical mass formula, radioactivity, 4. theory of alpha decay, G M counter, Scintillation counter etc.	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	Structure of the nucleus: Nuclear constituents, classification of nuclei, general properties of nucleus- the nuclear size, nuclear mass, density, charge, Mass spectroscopy, Proton –neutron theory of nuclear composition, atomic mass unit (a.m.u.) and mass-energy equivalence, mass defect and packing fraction, nuclear binding energy, binding energy per nucleon, variation of binding energy with mass number & its significance.	**10**
II.	Nuclear reactions and Nuclear reactors: Nuclear reactions, types of nuclear reactions, Q-value of a reaction, exothermic & endothermic reactions, theory of nuclear fission, energy released in nuclear fission, chain reaction, atom bombor nuclear bomb, nuclear fusion, distinction between nuclear fission and fusion, source of stellar energy, nuclearreactors.	**11**
III.	Nuclear forces, Nuclear models and Particle accelerators: Nuclear forces, Meson theory of nuclear forces, models of Nuclear structure – the liquid drop model, Semi empirical mass formula, nuclear shell model, introduction to particle accelerators, characteristics of an ion source, Cyclotron- its main components, construction and theory, Betatron- its construction and theory.	**9**
IV	Radioactivity and Nuclear detectors: Discovery of Radioactivity, nature of nuclear radiations, properties of alpha, beta and gamma rays, theory of alpha decay, natural and artificial radioactivity, fundamental laws of radioactivity, concept of half-life and disintegration constant, radioactive dating, Activity of Radioactive sources, its unit, Ionization chamber, Geiger-Muller counter, Scintillation counters and Solid state detectors.	**10**
	TOTAL	**40**

Text Book:

1. *Nuclear Physics*, D C Tayal, Himalaya Publishing House, 5th edition, 2011.

Reference Books:

1. Roy, R. R. & Nigam, B. P., *Nuclear Physics Theory and Experiments*, New Age International,2014.

6th Semester Syllabus

SYLLABUS (6th SEMESTER)

Paper I/Subject Name: Quantum Mechanics		**Subject Code: PHY012C601**
L-T-P-C: 4-1-0-5	**Credit Units: 5**	**Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To establish the first grounding in Quantum Mechanics which helps to study advanced courses inmasters.	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Blackbody radiation, Photoelectric effect, 2. de Broglie hypothesis, Uncertainty principle 3. Schrodinger's equation, Operators, 4. Application of Schrodinger's equation, etc	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	Inadequacies of classical Physics with examples. Black body radiation spectrum, Planck's Quantum Hypothesis, Planck's formula for black body radiation, Rayleigh-Jeans law and Wein's law as limiting cases, Photoelectric effect and Einstein's formula, Compton effect, Dual nature of light, Concept of photons.	**7**
II.	Wave properties of matter, de Broglie hypothesis, Davisson Germer's experiment and validation of de-Broglie hypothesis, Wave particle duality of matter, Uncertainty principle and some applications.	**10**
III.	Concept of wave function, Schrodinger's equation (time dependent and time independent), physical significance of wave function, well behaved wave function, Probability and Probability density, equation of continuity, Probability Current density, expectation value of any Physical property, Operators, position, linear momentum, Energy operator, unitary operator, Hermitian operator, commutation relation, Schrodinger's wave equation in operator form, Eigen function and Eigen value, angular momentum operator and its Eigen function and Eigen value.	**13**
IV	Application of Schrodinger's equation: particle in one dimensional box, potential step, potential barrier and tunnelling effect. One dimensional harmonic oscillator.	**10**
TOTAL		**40**

Text Book:

1. *Quantum Physics,* H.C. Verma, Surya Publications,2nd edition, 2012.

Reference Books:

1. Biswas S.N., *Quantum Mechanics*, Books and Allied ltd., 2nd revised edition, 2012.
2. NouredineZettili, *Quantum Mechanics*, Wiley publications, 2nd edition, 2009
3. David J Griffiths, *Introduction to Quantum Mechanics*, Pearson Education,2015

SYLLABUS (6th SEMESTER)

Paper II/Subject Name: Electrodynamics		**Subject Code: PHY012C602**
L-T-P-C: 4-1-0-5	**Credit Units: 5**	**Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To make the students understand the basics of electrostatics, magneto-statics and their dynamic behavior	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Coulomb's law, electric potential, electric potential energy of single charge, surface charge, 2. Force on a moving charge, curl and divergence of the magnetic field, Ampere's law, 3. Faraday's law, Poynting theorem, 4. Reflection and refraction, Snell's law etc.	A. Semester end examination : 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	Coulomb's law, concept of electric force, filed and flux; Gauss's law and its application; concept of electric potential, electric potential energy of single charge and a charge distribution; surface charge and the force on the surface of a conductor	**10**
II.	Force on a moving charge and current carrying conductor in a magnetic field; force between two current-carrying wires, general expressions for fields due to current densities, curl and divergence of the magnetic field, Ampere'slaw	**10**
III.	Motional electromotive force; Faraday's law, electromagnetic field equation in integral and differential form, displacement current, Maxwell's equations, energy conservation law, Poynting theorem.	**10**
IV	Electromagnetic wave equation, velocity of electromagnetic wave; monochromatic plane wave equation in free space and conducting medium; reflection and refraction of plane electromagnetic wave for normal and oblique incidence, Snell's law.	**10**
TOTAL		**40**

Text Book:

1. *Introduction to Electrodynamics,* Griffiths D.J., PHI, 4thEd., 2016, NewDelhi
2. *Electricity and Management,* Tayal D. C., Himalaya Publishing House, 4th ED., (Revised), 2014,Mumbai

Reference Books:

1. Chakraborty B., *Principles of Electrodynamics,* Books & Allied Ltd., 1st Ed., 2010, Kolkata

SYLLABUS (6th SEMESTER)

Paper III/Subject Name: Statistical Mechanics		**Subject Code: PHY012D601**
L-T-P-C: 4-1-0-5	**Credit Units: 5**	**Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To make the students understand the basics of electrostatics, magneto-statics and their dynamic behavior	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Probability distribution, introduction to statistical mechanics 2. Liouville's theorem, postulates of statistical mechanics 3. Concept of classical statistical mechanics 4. Introduction to Bose-Einstein and Fermi Dirac statistics Maxwell- Boltzmann statistic	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz : Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	Probability distribution, calculation of mean and standard deviations of quantity, elementary numerical problems, introduction to statistical mechanics	**8**
II.	State of the system (microscopic and macroscopic), phase space, density of states, Liouville's theorem, postulates of statistical mechanics, relation between thermodynamics and statistical parameters.	**10**
III.	Concept of classical statistical mechanics: Ensemble theory (micro-canonical, canonical and grand canonical ensemble), application to classical ideal gas and simple numerical problems, Maxwell-Boltzmann statistics.	**12**
IV	Concept of quantum statistical mechanics: introduction to Bose-Einstein and Fermi Dirac statistics, comparison of Bose-Einstein, Fermi-Dirac, and Maxwell-Boltzmann statistics, qualitative features of Fermi and Bosegas	**10**
TOTAL		**40**

Textbook:

1. *Statistical mechanics*, R. K Patharia, Elsevier publications, 3rdedition, 2011.

Reference Books:

1. Kerson H. *Statistical mechanics*, Wiley studentedition, 2008.
2. Silvio R and Salinas A, *Introduction to statistical Physics*, Springer India Pvt.Ltd., 2010.

SYLLABUS (6th SEMESTER)

Paper IV/Subject Name: Theory of Relativity		**Subject Code: PHY012D602**
L-T-P-C: 4-1-0-5	**Credit Units: 5**	**Scheme of Evaluation: T**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To make the students understand the basics of Relativity with respect to space and time	1. Lecture 2. Assignment 3. Individual and Group Presentation	On completion of this course students will be able to gain understanding of the followings 1. Concept of space, time and mass, frame of reference, Newtonian relativity, Michelson-Morley experiment, 2. Postulates of special theory of Relativity, Lorentz transformation, Length contraction and Time dilation, 3. Doppler Effect, Space-time diagram, 4. General Theory of Relativity (Elementary), etc	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: (Assignment, Class Test, Viva, Seminar, Quiz: Any Three:15, Mid-term examination: 10, Attendance: 5)

Detailed Syllabus:

Modules	Topics & Course Contents	Periods
I.	Concept of space, time and mass in Newtonian mechanics, frame of reference, inertial frame and non-inertial frame, equation of motion in non-inertial frame, Newtonian relativity, Galilean Transformation equations, the ether hypothesis, the Michelson-Morley experiment, explanation of the negative result.	**9**
II.	Constancy of speed of light. Postulates of special theory of Relativity. Lorentz transformation equations-its derivation, Inverse Lorentz transformation, Length contraction and Time dilation with illustrations, the Twin Paradox, Relativity of Simultaneity.	**10**
III.	Relativistic addition of velocities, variation of mass with velocity, mass-energy equivalence, relativistic formula for kinetic energy, unified mass unit, relationship between the total energy, the rest energy and the momentum, Doppler Effect.	**11**
IV	Space-time diagram, Minkowski'sfour-dimensional space-time continuum, world-line, world-point, geodesic, four vectors, four velocity, four momentum, four force, General Theory of Relativity (Elementary), effect of gravitational field ona ray light, gravitational red shift.	**10**
TOTAL		**40**

Textbook:

*1. Introduction to special relativit*y, Robert Resnick, John Wiley & Sons, Canada, Limited, 2007.

Reference Books:

1. Krori K.D*., Fundamentals of special and general relativity*, Publisher, PHI Learning Pvt. Ltd., 2010.

SYLLABUS (6th SEMESTER)

Paper V: Subject Name: Project /Literature survey		**Subject Code: PHY012D623**
L-T-P-C: 0-0-0-6	**Credit Units: 6**	**Scheme of Evaluation: T/P**

Course Objectives	Teaching Learning Process	Learning Outcomes	Course Evaluation
1. To improve the presentation skill and subject knowledge of the students	1. One to one guidance and supervision 2. Individual and Group Presentation	On completion of this course students will be expected to acquire confidence to present their research work in the future	A. Semester end examination: 70 marks B. Internal Assessment-30 marks: Presenation:20, Viva:10

Literature survey / Project