Parvatibai Chowgule College of Arts & Science (Autonomous), Margao, Goa

Department of Physics

Minutes of the First Board of Studies (Physics) Meeting

Date: 6th December, 2014

Time: 10:30 am - 4:00 pm

Venue: Conference Room, Parvatibai Chowgule College of Arts and Science

The Chairman, Dr. Ashish Desai, welcomed the members and gave a brief introduction of the new course structure which is to be introduced from the academic year 2015-16. He also briefed about the core and elective papers in Physics and the credits assigned to them. After the briefing the Agenda of the meeting was carried out.

Agenda

1. To approve the list of core and elective courses for undergraduate program in Physics.
2. To approve the syllabi of Semester I and Semester II for the academic year 2015-16.
3. Recommend panel of examiners to the Academic Council.
4. Any Other Business (A.O.B.)

Proceedings:

Agenda Item No.1.

To approve the list of core and elective courses for undergraduate program in Physics

1.1 Discussion on the list of core and elective courses for undergraduate program in Physics.

1. Dr. Ananya Das suggested that the course: Atomic and Molecular Physics is an important paper for students answering NET, SET and other competitive exams. As this course is currently not included in the present postgraduate syllabus of Physics, Goa University, it was decided to incorporate this paper as a core paper. Thus, the BoS members decided to offer Statistical Physics as an elective paper instead of Atomic and Molecular Physics.

2. Prof. Arun Kulkarni suggested that a remedial course in Mathematics with syllabus containing higher secondary level mathematics like Mensuration, Geometry, Vectors, Differentiation and Integration to be offered to the First Year B. Sc. Physics students apart from the core course in Mathematical Physics. This course will cater the need of those students who drop Mathematics at the higher secondary, which is an essential requirement to pursue undergraduate studies in Physics.

3. It was suggested by Prof. Kaustubh Priolkar, that courses in Basic Chemistry may also be offered, as interdisciplinary papers, to the students opting for Physics as their Major subject.

4. Mr. Pramod Maurya and Prof. Kaustubh Priolkar suggested that students opting some of the elective courses, need to complete the required prerequisite courses.

5. Mechanics is the cornerstone of pure and applied sciences and is an essential preparation for advanced physics, hence it is decided to offer Mechanics – I in the first semester and Heat and Thermodynamics in the second semester.

6. Prof. Priolkar suggested that the core compulsory papers for Minor in Physics may be offered to the students majoring in other subjects, as their interdisciplinary course. The titles of interdisciplinary courses are changed. It was also unanimously decided that these interdisciplinary courses could also be offered as an elective to the student opting for Major in Physics.

7. The BOS unanimously recommends twelve compulsory courses along with eight core electives courses for the student's opting Major in Physics. These twelve courses are essential learning required at undergraduate level. Out of these twelve courses, eight will be core compulsory courses and remaining four papers will be introduced one in each semester from III-VI as electives and they are named as Compulsory Core Electives (CCE).

8. The changes suggested in the title of the core and elective papers for both Major and Minor in Physics options are as follows:

   - "Electricity" (Core Compulsory paper) should be changed to "Electricity and Magnetism" and will be offered as core paper in Semester II. This will be a prerequisite

course for Electromagnetic Theory - I and Electromagnetic Theory – II which will be offered as a core paper in semester III and V.

- "Wave Mechanics" (Core Compulsory Elective paper) should be changed to "Quantum Mechanics" and will be offered in Semester V.
- "Electricity and Electronics" (Core Compulsory Papers for Minor) should be changed to "Electricity, Magnetism and Electronics" and will be offered in Semester-II
- "Introduction to Quantum Physics" (Core Compulsory Papers for Minor) should be changed to "Elementary Modern Physics" and will be offered in Semester IV.
- "Introduction to Solid State Physics" (Core Compulsory Papers for Minor) should be changed to "Material Science" and to be offered in Semester V.
- "Atomic, Molecular and Nuclear Physics" (Core Compulsory Papers for Minor) should be changed to "Atomic and Nuclear Physics" and will be offered in Semester VI.

1.2 Recommendation made with respect to implementation of the course structure

1. Prof. Arun Kulkarni suggested that the students should be offered more credits in the beginning of their undergraduate coursework with respect to the implementation of the course structure.
2. The BoS members of Physics strongly recommend the interdisciplinary papers to be offered in the first four semesters.

1.3 Resolution on the list of core and elective courses for undergraduate program in Physics

Based on the suggestions stated above, the list of core and elective courses for undergraduate program in Physics are modified. The modified list is presented in **Annexure I.** BoS in Physics unanimously decided to recommend the Academic Council to consider the suggestions made with respect to implementation of the course structure.

Agenda Item No.2.

To approve the syllabi of Semester I and Semester II for the academic year 2015-16.

2.1 Discussion on the syllabi of Semester I and Semester II for the academic year 2015-16.

2.1.1 Core Compulsory Papers for Major in Physics (Theory)

1. **Introduction to Mathematical Physics**
   - Prof. Arun Kulkarni suggested to introduce Vector Analysis in the syllabus and to remove Fourier series and Numerical methods. It was also suggested that Fourier series can be included in the paper titled Oscillation, Waves and Sound and Numerical Methods to be included in the paper titled Computational Physics.
   - It was suggested by Prof. Arun Kulkarni and Prof. Kaustubh Priolkar to change the title of the subsections "Linear differential equation of the second order with constant coefficients and zero right hand side and Linear differential equation of the second order with constant coefficients and right hand side not zero" to "Homogenous and inhomogeneous linear differential equation".
   - Prof. Arun Kulkarni suggested inclusion of Thermodynamic relations, which deals with partial differentiation identities.
   - The important references in this course should include:
     - Mathematical Methods for Physics and Engineering by Riley, Hobson and Bence
     - Mathematical methods for Physics and Engineering by Boas
     - Introduction to Mathematical Physics by Charlie Harper
     - Mathematics of Physics and Modern Engineering by Sokolnikoff and Redheffer
     - Schaum's Outline of Vector Analysis by M. Spiegel, S. Lipschutz, and D. Spellman
     - Mathematics of Classical and Quantum Physics by Byron and Fuller

2. **Mechanics-I**
   - Prof. Arun Kulkarni suggested to include the reference book Classical Mechanics by John Taylor and Mechanics by Keith Symon instead of Mechanics by Hans and Puri.

- It was also suggested by Prof. Arun Kulkarni to change the Mechanics-I syllabus to include first four chapters from the book Mechanics by John Taylor (i.e. Newton's laws of motion, Projectiles and charged particles, Momentum and angular momentum and Energy) along with the topics: Newton's law of Gravitation and Gravitational Potential.

- The important references in this course should include:
  - Classical Mechanics by John Taylor
  - Mechanics by K. Symon
  - An Introduction to Mechanics by Kleppner and Kolenkow,
  - Mechanics (Berkley Physics Course, Vol I) by Kittle and Knight
  - Newtonian Mechanics by A.P. French

3. Heat and Thermodynamics

- It was suggested to change the order of the sections to
  i. Principle of Thermometry
  ii. Laws of Thermodynamics
  iii. Equations of State
  iv. Applications of First and Second Law of Thermodynamics
  v. Concept of Entropy
- Dr. Ananya Das suggested to introduce the Third law of Thermodynamics in the syllabus and should be included at the end of the fifth unit (Concept of Entropy).
- Prof. Kulkarni and Prof. Priolkar suggested the Kinetic theory of gases should be included either in the paper Heat and Thermodynamics or Statistical Physics.
- The important references in this course should include:
  - Fundamental of Statistical and Thermal Physics by F. Reif
  - A Treatise on Heat by Saha and Shrivastava
  - Thermodynamics for Engineers by K. Wong

4. Electricity and Magnetism

- Prof. Arun Kulkarni recommended the contents of chapters 22-31 from the book titled Fundamantals of Physics by Halliday, Resnick and Walker for framing of the syllabus.

- It was suggested by Mr. Deepak Kumar not to include circuit analysis in this syllabus, since students find it difficult to grasp at the first year level. It was decided by the BoS that the circuit analysis could be included in the compulsory core elective paper titled Electronics-I, which will be offered in Sem. III.

5. **Optics**
   - As Optics was shifted to Semester IV the syllabus of the paper was not discussed in this meeting.

2.1.2 Core Compulsory Papers for Major in Physics (Practical)

It was decided that the students will have to perform minimum six experiments in each paper.

1. **Introduction to Mathematical Physics**
   - The Error analysis should include principal of the Vernier Calliper, Binomial distribution, Gaussian distribution, Poisson distribution and radioactive law
   - As the software Mathematica is expensive, alternative ways for solving differential equation using software may also be looked into.

2. **Mechanics –I**
   - Atwood machine and simple pendulum should be included in the list of experiments.

3. **Heat and Thermodynamics**

   Following experiments should be included in the list of experiments
   - Latent heat of Ice (Calorimeter)
   - Thermal conductivity of Copper
   - Temperature coefficient of resistance of Platinum thermometer using PT-100

4. **Electricity and Magnetism**
   - To be framed.

2.1.3 Core Compulsory Papers for Minor in Physics (Theory)

1. **Mechanics, Properties of Matter and Sound**
   - No changes were suggested in the syllabus.

2. **Electricity, Magnetism and Electronics**
   - Syllabus for this paper to be framed.

3. **Heat and Optics**

   The syllabus of the core minor Heat and Optics, which is shifted to Semester III, was discussed and some changes were recommended.

   - It was suggested to change the order of the sections to
     - vi. Principle of Thermometry
     - vii. Laws of Thermodynamics
     - viii. Equations of State
   - Prof. Priolkar suggested clubbing together Interference, Diffraction and Polarization in one unit of the optics section and including just one example of each.

2.1.4 Core Compulsory Papers for Minor in Physics (Practical)

1. **Mechanics, Properties of Matter and Sound**

   List of experiments for this paper was approved without any changes

2. **Electricity, Magnetism and Electronics**
   - To be framed.

2.2 Resolution on the syllabi of Semester I and Semester II for the academic year 2015-16

The syllabi of the paper titled Electricity and Magnetism and the paper titled Electricity, Magnetism and Electronics along with the redrafted syllabi will be circulated among all the members of BoS for their approval. The redrafted and the newly framed syllabi of Semester I and Semester II are presented in **Annexure II.**

Agenda Item No.3.

Recommend panel of examiners to the Academic Council.

The BoS in Physics approved the list of panel of examiners to be recommended to the Academic Council. The list of names of the external examiners is presented in **Annexure III.**

The Chairman thanked the members of Board of Studies in Physics for their valuable contribution and active participation.

The following members of Board of Studies in Physics were present for the meeting:

1. Dr. Ashish Desai (Chairman)
2. Mrs. Malati Dessai
3. Dr. Ananya Das
4. Mr. Yatin Desai
5. Dr. Reshma Raut Dessai (Member Secretary)
6. Ms. Vaishali Gaonkar
7. Prof. Kaustubh Priolkar (Academic Council Nominee)
8. Prof. A.V. Kulkarni (Academic Council Nominee)
9. Mr. Pramod Maurya (Industry Representative)
10. Mr. Deepak Kumar (Postgraduate Alumni)

Due to prior commitments Dr. Preeti Bhobe (Vice-Chancellor Nominee) conveyed her inability to attend the meeting.

Date: January 8, 2015

Dr. Ashish M. Desai
Chairman
BoS (Physics)

Dr. Reshma Raut Dessai
Member Secretary
BoS (Physics)

Annexure I

Core Compulsory Papers for Major in Physics (CC)

Sr. No	Semester	Title of the Paper	Code
1	I	Introduction to Mathematical Physics	PHY-I.C-1
2	I	Mechanics-I	PHY-I.C-2
3	II	Heat and Thermodynamics	PHY-II.C-3
4	II	Electricity and Magnetism	PHY-II.C-4
5	III	Electromagnetic Theory-I	PHY-III.C-5
6	IV	Optics	PHY-IV.C-6
7	V	Electromagnetic Theory-II	PHY-V.C-7
8	VI	Atomic and Molecular Physics	PHY-VI.C-8

Core Elective Papers for Major in Physics (CE)

Sr. No	Semester	Title of the Paper	Code
1	III	Electronics-I (CCE)	PHY-III.CE-1
2	III	Astronomy and Astrophysics	PHY-III.CE-2
3	III	Modern Physics	PHY-III.CE-3
4	III	Solid State Devices	PHY-III.CE-4
5	IV	Oscillations, Waves and Sound (CCE)	PHY-IV.CE-5
6	IV	Properties of Matter and Acoustics	PHY-IV.CE-6
7	IV	Computational Physics	PHY-IV.CE-7

8	IV	Mechanics II	PHY-IV.CE-8
9	V	Quantum Mechanics (CCE)	PHY-V.CE-9
10	V	Statistical Physics	PHY-V.CE-10
11	V	Electronics-II	PHY-V.CE-11
12	V	Introduction to Nanoscience	PHY-V.CE-12
13	VI	Solid State Physics (CCE)	PHY-VI.CE-13
14	VI	Nuclear and Elementary Particle Physics	PHY-VI.CE-14
15	VI	Introduction to Special Theory of Relativity	PHY-VI.CE-15
16	VI	Introduction to Physical Oceanography	PHY-VI.CE-16

Note:

CCE- Core compulsory Electives

These are compulsory electives which a students must offer while selecting Elective course in respective semester.

Core Compulsory Papers for Minor in Physics (CM)

Sr. No.	Semester	Title of the Paper	Code
1	I	Mechanics, Properties of Matter and Sound	PHY-I.CM-1
2	II	Electricity, Magnetism and Electronics	PHY-II.CM-2
3	III	Elementary Modern Physics	PHY-III.CM-3
4	IV	Heat and Optics	PHY-IV.CM-4
5	V	Material Science	PHY-V.CM-5
6	VI	Atomic and Nuclear Physics	PHY-VI.CM-6

Interdisciplinary papers:

Sr. No.	Title of the Paper
1	History and Philosophy of Science
2	Technological Evolution through Physics
3	Energy Studies

Annexure II

Parvatibai Chowgule College of Arts and Science (Autonomous)

Margao, Goa

Syllabus for

Semester I and Semester II

for the undergraduate course

in

Physics

(2015-2016)

Core Compulsory papers for Major in Physics

Semester 1:

1. Introduction to Mathematical Physics
2. Mechanics-I

Semester II:

1. Heat and Thermodynamics
2. Electricity and Magnetism

Paper Title : Introduction to Mathematical Physics

Paper Code : PHY-I.C-1

Name of Faculty: Ashish Desai

Marks : 75 (Theory) + 25 (Practical)

Credits : 3 (Theory) + 1 (Practical)

Contact Hours : 45 (Theory) + 30 (Practical)

Course Objectives: To develop basic competence in certain areas of mathematics required for understanding several important topics in physics.

Learning outcome: After successful completion of this course, student will comprehend some of the important mathematical concepts and should be able to use these methods to solve several problems in Physics.

Theory:

1. **Vector Analysis** **[6]**
   Scalars and vectors, Basis vectors and components, Multiplication of Vectors. Equation of lines and planes. Using vectors to find distances. Reciprocal vectors. Differentiation and Integration of vectors.

   [Riley 6.1, 6.3-6.9, 8.1, 8.2]

2. **Infinite Series and Power Series** **[6]**
   Geometric Series and other infinite series. Convergent and Divergent Series. Testing series for convergence. Power series. Expanding functions in power series. Techniques for obtaining power series expansion.

   [Boas 1.1-1.6, 1.10-1.13]

3. **Complex Numbers** **[6]**
   Real and imaginary Parts of a complex number. Complex plane. Complex algebra. Euler's formula. Powers and roots of complex numbers. Exponential and trigonometric functions.

   [Boas 2.1-2.5, 2.9-2.11]

4. **Matrices** **[6]**
   Matrix Analysis and Notation, Matrix Operations, Properties of matrices. Transpose matrix. Complex Conjugate Matrix, Hermitian Matrix, Unit matrix, Diagonal matrix,

Adjoint and self-adjoint matrix, symmetric matrix, anti-symmetric matrix, unitary matrix, orthogonal matrix, trace of a matrix, inverse matrix.

[Harper 2.3, 2.4, 2.5 and 2.6]

5. **Partial Differentiation** **[7]**
Definition of the partial derivative. Total differentials. Exact and inexact differentials. Theorems of partial differentiation. Chain rule. Thermodynamic relations. Differentiation of Integrals.

[Riley 4.1-4.5, 4.10-4.11]

6. **Ordinary Differential Equation** **[8]**
Introduction. Linear differential equation of the first order. Homogenous and inhomogeneous linear differential equation of the second order.

[Boas 8.1-8.6 and Harper 5.1-5.2]

7. **Coordinate Systems** **[6]**
Plane polar coordinates. Cylindrical and Spherical polar coordinates.

[Harper 1.6.6, Riley 8.9]

Experiments: (Minimum Six)

1. Least count of Instruments (Vernier Caliper, Screw Gauge, Travelling Microscope and Spectrometer).
2. Error Analysis
3. Application of Error Analysis
4. Plotting of various algebraic and trigonometric functions using Excel.
5. Fitting of given data using Excel.
6. Interpretation of graphs.
7. Solving Integration, Ordinary Differential Equation and Matrices using Mathematica.
8. Tutorial
9. Tutorial

References:

1. K. F. Riley, M. P. Hobson and S. J. Bence, *Mathematical Methods for Physics and Engineering* (Cambridge University Press, 1998)
2. Mary L. Boas, *Mathematical Methods in Physical Sciences* (John Wiley and Sons, 3rd Edition)
3. Charlie Harper, *Introduction to Mathematical Physics*- (Prentice Hall)

Additional References:

1. B. D. Gupta, *Mathematical Physics* (Vikas Publishing House, 2004)

2. M. Spiegel, S. Lipschutz, D. Spellman, *Schaum's Outline of Vector Analysis,* (McGraw Hill Education, 2009)

Paper Title : Mechanics I

Paper Code : PHY-II.C-2

Name of Faculty : Malati Dessai

Marks : 75 (Theory) + 25 (Practical)

Credits : 3 (Theory) + 1 (Practical)

Contact Hours : 45 (Theory) + 30 (Practical)

Course Objectives: This course provides an introduction to topics in mechanics, which are essential for advanced work in physics. An objective of this course is to train students to think about some of the physical phenomenon in mathematical terms.

Learning outcome: After successful completion of this course, Students will develop qualitative and quantitative understanding of Newtonian mechanics in one and two dimensions, its conservation laws, Gravitation fields and potentials and their applications to basic physical problems familiar from the everyday world.

Theory:

1. **Newton's Laws of Motion [10]**
   Brief description of classical view of Space and Time (vector operations). The concept of Mass and Force. Newton's First and Second Laws; Inertial frames. Equations of motion. Interpretation of Newtons third Law as Conservation of Momentum. Newton's Second Law in Cartesian coordinates and in two dimensional Polar coordinates. Applications of Newtons Laws: Atwood Machine, Free fall near surface of the earth, simple harmonic motion and time dependent force.

   [Taylor 1.1-1.7, Kleppner 2.4]

2. **Projectiles and Charged Particles [10]**
   Motion of projectile in air resistance/drag (function of velocity.) Linear Air Resistance. Horizontal and vertical motion with linear drag, Trajectory and Range in a Linear Medium. Quadratic Air Resistance. Horizontal motion with quadratic drag (ignoring gravity), Motion of a charged particle with a velocity perpendicular to the direction of a uniform constant (1) electric field, (2) magnetic field and (3) electric and magnetic field (crossed) in mutually perpendicular directions. Lorentz force.

   [Taylor 2.1 - 2.7, Symon 3.17]

3. **Momentum and Angular Momentum [7]**

Principle of conservation of momentum (Elastic and Inelastic collision), Analysis of Rocket motion. The Centre of Mass, Angular Momentum for a Single Particle. Kepler's second law as a consequence of conservation of angular momentum.

[Taylor 3.1-3.5]

4. **Work and Energy** **[10]**

Kinetic Energy and Work: Work energy theorem. Potential Energy and Conservative Forces. Force as a Gradient of Potential Energy, Time dependent potential energy (one dimension). Energy for Linear One-Dimensional Systems. Curvilinear one-dimensional systems. Energy of interaction of two particles in one dimension.

[Taylor 4.1-4.3, 4.5-4.7, 4.9]

5. **Gravitation Field and potentials** **[8]**

Newton's Law of Gravitation. Gravitational field. Gravitational potential energy. Equipotential surface. Gravitational potential and field due to a (1) thin spherical shell, (2) uniform hollow sphere and (3) thin circular plate.

[Brijlal 5.5-5.8, 5.10, 5.11]

Experiments: (Minimum Six)

1. Dimensions of different solid body
2. Moment of Inertia of a flywheel
3. Atwood Machine
4. Verification of Newton's Second Law using Air Track
5. Conservation of linear momentum using Air Track
6. Spring Mass System: Determining the Spring Constant
7. Simple Pendulum
8. Log Decrement
9. Determining "**g**" using time of flight method using Python

References:

1. John Taylor, *Classical Mechanics*, (University Science Books, 2004)
2. Kleppner and Kolenkow, *Introduction to Mechanics*,(Cambridge University Press, 2013)
3. K. R. Symon, *Mechanics* (Addison Wesley, 1971)
4. Brij Lal and N. Subrahmanyam, *Mechanics and Electrodynamics*, (S. Chand and Company LTD , 2005)

Additional References:

1. Kittle and Knight, Mechanics (Berkeley Physics Course, Vol. 1), (McGraw Hill Education, 2011)
2. D. S. Mathur, *Mechanics* (S. Chand & Co., 2005)
3. R. G. Takawale and P. S. Puranik, *Introduction to Classical Mechanics*, (Tata McGraw-Hill, 1997)
4. Javier E. Hasbun, *Classical Mechanics* (Jones and Bartlett India Pvt. Ltd. 2010)
5. Atam Arya, *Introduction to Newtonian Mechanics*, (Addison-Wesley, 1997))
6. R. G. Takawale and P. S. Puranik, *Introduction to Classical Mechanics* (Tata McGraw-Hill, 1997)
7. Javier E. Hasbun, *Classical Mechanics* (Jones and Bartlett India Pvt. Ltd. 2010)

Paper Title : **Heat and Thermodynamics**

Paper Code : **PHY-II.C-3**

Name of Faculty : **Yatin P. Desai**

Marks : **75 (Theory) + 25 (Practical)**

Credits : **3 (Theory) + 1 (Practical)**

Contact Hours : **45 (Theory) + 30 (Practical)**

Course Objectives : To acquaint students with fundamental concepts of Thermal Physics and explain the usefulness of these concepts for wide range of applications that include heat engines, refrigerators and air conditioners.

Learning outcome : At the end of this course students would understand the movement of heat (energy) and how energy instills movement. More precisely students would be able to relate the effects of changes in temperature, pressure and volume on physical systems at macroscopic scale by analyzing collective motion of their particles.

Theory:

1. **Principle of Thermometry [5]**
   Review of concept of heat and temperature, Thermometry, Types of thermometers, Centrigrade, Fahrenheit, Rankine Scales and relations between them, Platinum resistance thermometer, Thermocouple (thermoelectric) thermometers.

   [Ref. No. 1: 13.1 – 13.5, 13.15, 13.23]

2. **Laws of Thermodynamics [14]**
   Thermodynamic system, Thermodynamic variables, Thermodynamic equilibrium, and Thermodynamic processes, Zeroth law of thermodynamics, Concept of work and internal energy, First law of thermodynamics, Isothermal and adiabatic changes, Work done in isothermal and adiabatic changes, Relation between pressure, volume and temperature in adiabatic process, Reversible and irreversible processes, Carnot Heat engine, Carnot cycle for perfect gas, efficiency, Second law of thermodynamics (Kelvin – Planck Statement, Clausius Statement)

   [Ref. No. 1: 4.1, 4.4 – 4.7, 4.10.4, 4.11 - 4.13, 4.20 – 4.24, 4.28]

3. **Equations of State [6]**
   Equation of state, Andrew's experiment, Amagat's experiment, Van der Waal's equation of State, Critical constants, Reduced equation of state, Boyle temperature.

   [Ref. No. 2: 10.1 -10.6], [Ref. No. 1: 2.6, 2.14]

4. **Applications of First and Second Law of Thermodynamics [14]**
   Otto cycle and Otto engine, Diesel cycle and Diesel engine, Efficiencies, Introduction to refrigeration, Principle and coefficient of performance, Principle of air conditioning, comfort chart A.C. machine, factors affecting size and capacity of A.C. machines.

   [Ref. No. 2: 4.16 – 4.19], [Ref. No. 1: 4.26, 4.27, Chapter 17]

5. **Concept of Entropy [6]**
   Changes of entropy during reversible and irreversible process, Temperature – Entropy diagram, Temperature – Entropy diagram of Carnot's cycle, Physical significance of Entropy, Entropy of a perfect gas, Principle of increase of entropy, Third Law of Thermodynamics.

   [Ref. No. 2: 6.9, 6.12], [Ref. No. 1: 5.1 – 5.8]

Experiments: (Minimum Six)

1. Latent heat of ice
2. Calibration of Si diode as a thermometer.
3. Constant volume air thermometer.
4. Constant pressure air thermometer.
5. Thermal conductivity by Lee's method.
6. Thermal conductivity of copper.
7. Temperature coefficient of resistance of copper.
8. Temperature coefficient of resistance of Platinum thermometer using PT-100.

References:

1. Brijlal, Subramanyam N., Hemne P.S., Heat Thermodynamics and Statistical Physics, S. Chand (2007)
2. Saha M.N., Shrivastava B.N., Treatise on Heat, The Indian Press 5th Ed. (1965)

Additional References:

1. Roberts J. K., Miller A.R., Thermodynamics, E.L.B.S. (1960)
2. Zemansky M.W., Ditman R.H., Heat and Thermodynamics, McGraw Hill, 8th Ed. (5th reprint), 2013

Paper Title : **Electricity and Magnetism**

Paper Code : **PHY-II.C-4**

Name of Faculty : **Ananya Das**

Marks : **75 (Theory) + 25 (Practical)**

Credits : **3 (Theory) + 1 (Practical)**

Contact Hours : **45 (Theory) + 30 (Practical)**

Course Objectives : The objective of this course is to introduce fundamentals of electricity and magnetism to the students, which is an essential preparation for more advanced courses like Electromagnetic theory.

Learning Outcome : On successful completion of this course, the students will be able to:

- Comprehend basic concepts like: laws of electrostatics and magnetostatics and also related applications.
- Understand the interrelated concepts of Electricity and Magnetism.
- Understand the working of transient circuits and alternating current circuits.
- Correlate the theoretical basis of various concepts of electricity and magnetism while performing experiments.

Theory:

1: Electrostatics **[8L]**

Coulomb's law: Statement, Vector form of Coulomb's law for like and unlike charges,

Variation of force with distance (F.vs.r graph),

Concept of electric field and Electric Field Lines:

Electric field, Electric field due to (i) a Point Charge, (ii) an Electric Dipole, (iii) a Line of Charge and a Charged Disk,

Concept of electric flux: Gauss' Law of electrostatics (Conceptual explanation),

Applications of Gauss law: Coulomb's Law from Gauss' Law, Electric Field due to (i) an isolated uniformly charged sphere, (ii) an uniform distribution of charge throughout the sphere and (iii) an uniformly charged hollow cylinder,

Electric Field near (i) a charged infinite cylindrical conductor or a cable and (ii) a plane of

sheet charge

Concept of Electric Potential: Electric Potential Energy, Equipotential Surfaces,

Calculating the Potential from the Field

Potential due to (i) a Point Charge, (ii) a Group of Point Charges and (iii) an Electric Dipole

Calculating the Field from the Potential

[Ref. No.1: 22.4, 23.2-23.7, 24.1-24.5, 25.1-25.7, 25.9] [Ref. No.2: 2.4(1-6)]

2 : Capacitors and Dielectrics [5L]

Capacitance: Calculation of capacitance of (i) a Parallel-Plate Capacitor, (ii) a Cylindrical Capacitor and (iii) a Spherical Capacitor; Energy stored in an electric field,

Capacitor with a Dielectric, Dielectrics: An Atomic View, Dielectrics and Gauss' Law,

Relation between three electric vectors (E, D and P)(Without derivation, qualitative discussion only)

[Ref. No.1: 26.1- 26.3, 26.5-26.8]

3 : Magnetostatics [7L]

Concept of magnetic field: Definition and properties of magnetic field

Biot–Savart's law and its applications: (i) a long straight wire and (ii) a current carrying circular loop (for a point on the axis only)

Ampere's circuital law and its applications: (i) Field of solenoid and (ii) Field of toroidal solenoid

Magnetic Field lines and Magnetic flux; Gauss' law for magnetism

[Ref. No.1: 29.1, 29.2, 30.1, 30.3, 30.4, 32.2][Ref. No.3:27.2, 27.3]

4: Self and Mutual Inductance [6L]

Self induction; Calculation of self inductance of (i) a long solenoid, (ii) long parallel wires and (iii) a coaxial cable

Mutual inductance, Coefficient of coupling; Calculation of mutual inductance between two

coaxial solenoids, Mutual inductance of two coils in series

Energy stored in a magnetic field and Energy density of a magnetic field

[Ref. No.4: 5.1, 5.2, 5.8, 5.9] [Ref. No.1:31.8, 31.10, 31.11, 31.12]

5 : Magnetic Properties of Material [4L]

Magnetic Materials, Bohr magneton.

Magnetisation (M), Magnetic Intensity (H) and magnetic induction (B)

Magnetisation, Susceptibility and Magnetic permeability

Relation between B, M and H (without derivation, qualitative discussion only)

. Diamagnetic, paramagnetic and ferromagnetic. Explanation with the help of

susceptibility and permeability, Hysteresis

[Ref. No.3:28.8]

6 : Transient Circuits [6L]

Transient currents

Growth and Decay of current in an inductive (L-R) circuit, Physical meaning of time

constant

Charging and Discharging of a capacitor through resistor in C-R circuit, Physical

meaning of time constant

Charging and Discharging of a capacitor through resistor and inductor in L-C-R circuit:

Over damped, Critically damped and Under damped conditions of L-C-R circuit

[Ref. No.4:5.3, 5.4, 5.13, 5.14]

7: Alternating Current Circuits [9L]

Inductive and Capacitive reactance, Variation of inductive reactance and capacitance reactances with frequency

Introduction to vector or phasor diagrams method and its application to A.C. circuits(Series L-R, Series C-R, Series L-C-R and Parallel L-C-R)

Introduction to j-operator method and its application to A.C. circuits(Series L-C-R and Parallel L-C-R)

Physical significance of Series resonance, Parallel resonance, Quality factor and Bandwidth, Graphical representation of resonance

A.C. bridges: Maxwell’s inductive bridge, Maxwell's L/C bridge, de Sauty's capacitance

bridge, Wien's frequency bridge.

[Ref. No.2:22.3, 22.4, 22.6, 22.7, 22.8, 22.9, 22.10, 22.13, 22.14]

[Ref. No.2: 22.19, 22.20, 22.21(b), 22.22]

[Ref. No.4:6.5, 6.6, 6.7(c), 6.9, 6.14, 6.20, 6.21, 6.22, 6.24]

Experiments: (Minimum Six)

1.Measurement of Dielectric constant of a liquid using two co-axial metal tubes.
2. Susceptibility measurement of a parallel plate capacitor in a dielectric medium
3. Step Response of RC circuit
4 .Transient response of L-C-R circuit using square wave generator and C.R.O.
5. Response of LR and CR circuits to A.C. - phasor diagrams
6. LCR Series and parallel resonance –Resonant frequency, Q value and Bandwidth
7. Determination of Mutual Inductance using LCR series resonance
8. de Sauty's bridge / Maxwells L/C bridge

References:

1. Halliday David, Resnik Robert and Walker Jearl, Fundamentals of Physics, John Wiley & Sons, Inc., 6th Edition (2003)
2. Vasudeva D. N., Fundamentals of Magnetism and Electricity, S. Chand & Company Ltd., 12th Revised Edition (1999)
3. Young Hugh D., Freedman Roger A. and Ford A. Lewis, Sears and Zemansky's University Physics with Modern Physics, Addison-Wesley Publishers, 13th Edition(PDF) (2012)
4. Fewkes J. H. and Yarwood John, Electricity, Magnetism and Atomic Physics, Volume I, Oxford University Press Ltd., 10th Impression (1991)

Additional References:

1. Purcell Edward M., Electricity and Magnetism-Berkeley Physics Course,Volume 2, McGraw-Hill Book Company (PDF)

Core Compulsory papers for Minor in Physics

Semester I:

1. Mechanics, Sound and Properties of Matter

Semester II:

2. Electricity, Magnetism and Electronics

Paper Title : Mechanics, Sound and Properties of Matter

Paper Code : PHY-I.CM-1

Name of Faculty: Malati Dessai and Ashish Desai

Marks : 75 (Theory) + 25 (Practical)

Credits : 3 (Theory) + 1 (Practical)

Contact Hours : 45 (Theory) + 30 (Practical)

Course Objectives: This course provides an introduction to topics in mechanics, sound and properties of matter. An objective of this course is to build up an understanding of fundamental physical principles which are required for most of other physical sciences.

Learning outcome: After successful completion of this course,

- Students will gain an introductory knowledge of Newtonian mechanics, its conservation laws and its applications to basic physical problems.
- They will have knowledge of waves, sound and ultrasonic waves and its application.
- Students will be able to comprehend the phenomenon of elasticity, surface tension, viscosity and their application.

1. **Elements of Newtonian Mechanics** **[5]**
   Newton's Laws of motion, equation of motion. Elementary problems in mechanics: Atwood machine and motion along a rough inclined plane and free fall.

   [Symon 1.4, 1.7]

2. **Motion of a particle in one dimension** **[10]**
   Momentum and energy conservation theorems. Discussion of the general problem of one dimensional motion. Applied force depending on time. Motion under damping force depending on velocity. Conservative force depending on position. Brief review of simple harmonic motion and potential energy curve. Body falling under gravity in a resistive medium proportional to velocity.
   [Symon 2.1 - 2.7]

3. **Gravitation Field and potentials:** **[6]**
   Newton's Law of Gravitation. Gravitation field and Gravitation potential energy, Gravitational potential and field due to a thin spherical shell.

   [Brij Lal 5.5-5.8]

4. Sound **[10]**

Transverse vibrations in strings.Velocity of longitudinal waves in gases. Newton's formula for velocity of sound. Velocity in a homogeneous medium. Laplace's correction. Kundt's tube-determination of velocity of sound in a gas and in solids. Intensity level and Bel and Decibel. Doppler Effect. Source and listener in relative motion (Normal incidence only). Production and detection of Ultrasonic waves and its applications.

[Khanna 4.2, 5.3-5.5, 11.1, 11.3, 12.1-12.4, 19.6 and Subra. 11.23 11.25,11.27]

5. Elasticity **[8]**

Modulii of elasticity, Poisson's ratio and relationship between them. Bending of beams-bending moment, flexural rigidity. Cantilever (rectangular bar). Depression of a beam supported at the ends and loaded at the center. A vibrating cantilever. Torsion in a string-couple per unit twist, Torsional Pendulum.

[Mathur 8.8, 8.9, 8.12 -8.18, 8.22, 8.26, 8.29, 8.30]

6. Surface Tension **[3]**

Brief review of molecular theory of surface tension. Relation between surface tension and surface energy. Angle of contact. Capillarity-rise of liquid in a capillary tube.

[Mathur 14.1-14.4, 14.6, 14.14, 14.15 and 14.17]

7. Viscosity **[3]**

Streamline flow, Turbulent flow, Critical velocity, Coefficient of viscosity, Poiseuille's formula for flow of liquid through a capillary tube.

[Mathur 12.1, 12.2, 12.7, 12.11]

List of Experiments: (Minimum Six: Three from each section)

I. **Mechanics and Sound**

1. Dimensions of different solid body
2. Moment of Inertia of a flywheel
3. Spring Mass System: Determining the Spring Constant
4. Velocity of sound by Helmholtz Resonator

II. Properties of Matter

1. Young's Modulus by Vibration
2. Young's Modulus by Bending
3. Surface Tension by rise of a liquid in a capillary tube.
4. Coefficient of Viscosity by Poiseuille's Method.

eferences:

1. K. R. Symon, *Mechanics (*Addison Wesley, 1971)
2. Brij Lal and N. Subrahmanyam, *Mechanics and Electrodynamics*, (S. Chand and Company LTD , 2005)
3. D. R. Khanna and R. S. Bedi ,*A Textbook of Sound* (Atma Ram and Sons, 1992)
4. N. Subrahmanyam and Brijlal, *Waves and Oscillation* (Vikas Publishing House 1994)
5. D. S. Mathur, *Elements of Properties of Matter* (S.Chand & Co. 2005)

Additional References:

1. John Taylor, Classical Mechanics (University Science Books, 2004)
2. Atam Arya, *Introduction to Newtonian Mechanics,* (Addison-Wesley, 1997)
3. Kittle and Knight, Mechanics (Berkeley Physics Course, Vol. 1), (McGraw Hill Education, 2011)
4. R. G. Takawale and P. S. Puranik, *Introduction to Classical Mechanics*, (Tata McGraw-Hill, 1997)
5. R. Murugeshan and Er. Kiruthiga Sivaprasath, *Properties of Matter and Acoustics* (S. Chand & Co., 2011)

Paper Title : Electricity, Magnetism and Electronics

Paper Code : PHY-II.CM-2

Name of Faculty: Ananya Das and Vaishali Gaonkar

Marks : 75 (Theory) + 25 (Practical)

Credits : 3 (Theory) + 1 (Practical)

Contact Hours : 45 (Theory) + 30 (Practical)

Course Objectives: The objective of this course is to introduce fundamentals of electricity, magnetism and basic electronics to the students, which are essential allied learning components for most of the subjects of Physical Sciences.

Learning Outcome: On successful completion of this course, the students will be able to:

- Comprehend basic concepts like: laws of electrostatics and magnetostatics, self and mutual inductions
- Understand the working of d.c. and a.c. circuits in terms of the role of passive components like capacitor and inductor present in the circuits.
- Understand the working and application of various electronic circuits like rectifier, voltage regulator, CE Amplifier, Op-Amps and Logic gates.
- Correlate the theoretical basis of various concepts of electricity, magnetism and electronics while performing experiments.

Theory:

I. Electricity and Magnetism [23L]

1: Laws of Electrostatics [5L]

Coulomb's law: Statement, Vector form of Coulomb's law for like and unlike charges, Variation force with distance (F v/s r graph)

Concept of electric field and Electric Field Lines

Concept of electric flux: Gauss's theorem in electrostatics (conceptual explanation)

Coulomb's Law from Gauss' Law

Concept of Electric Potential: Electric Potential Energy, Equipotential Surfaces

Calculating the Potential from the Field, Calculating the Field from the Potential

[Ref. No.1: 22.4, 23.2, 23.3, 24.1-24.5, 25.1-25.4, 25.9] [Ref. No.2: 2.4(1)]

2 : Laws of Magnetostatics [4L]

Concept of magnetic field, Definition and properties of magnetic field

Biot – Savart's law and its applications: (i) Long straight conductor and (ii) Current carrying circular loop (for a point on the axis only)

Ampere's circuital law and its application: Field of solenoid.

Magnetic Field lines and Magnetic flux, Gauss's law for magnetism

[Ref. No.1: 29.1, 29.2, 30.1, 30.3, 32.2][Ref. No.3:27.2, 27.3]

3: Self and Mutual Inductance [5L]

Self induction; Calculation of self inductance of (i) a long solenoid, (ii) long parallel wires and (iii) a coaxial cable

Mutual inductance, Coefficient of coupling; Mutual inductance of two coils in series

Energy stored in the magnetic field

[Ref. No.4: 5.1, 5.2, 5.8] [Ref. No.1:31.8, 31.10, 31.12]

4 : Transient Circuits and Alternating Current Circuits [9L]

Transient currents

Growth and Decay of current in an inductive (L-R) circuit, Physical meaning of time constant

Charging and Discharging of a capacitor through resistor in C-R circuit, Physical meaning of time constant

[Ref. No.4:5.3, 5.4]

Inductive and Capacitive reactance, Variation of inductive reactance, capacitance reactance with frequency.

Introduction to vector or phasor diagrams method and its application to A.C. circuits(Series L-R and Series C-R); Physical significance of Quality factor

A.C. bridges: Maxwell's Inductive bridge and de Sauty's Capacitance bridge

[Ref. No.2:22.3, 22.4, 22.6, 22.7, 22.8, 22.9, 22.10] [Ref. No.4: 6.20, 6.21, 6.22]

II. Electronics [22L]

5: Rectifiers and Regulators [6L]

Volt-ampere characteristics of Junction diode

Working of Half Wave and Full Wave Rectifiers without and with capacitive filters, Percentage regulation, Ripple factor and Rectification efficiency (only qualitative explanation with respect to HWR and FWR).

Zener diode characteristics and its use as a simple voltage regulator.
Thermistor characteristics and its use in A.C. voltage regulation.

[Ref. No. 1: 4.1-4.7 and Ref. No. 2: 6.1-6.4, 6.13-6.17]

6: Transistors [8L]

Basic configurations of transistors, Transistor's leads identification, Biasing of Transistor and working of Transistor as a switch
Transistor characteristic in CE and CB mode, Current gains and their interrelation,
Leakage currents in transistor
Basic Amplifier Characteristics: Current gain, Voltage gain, Power gain, Input resistance, Output resistance
Classes of amplifier operations, DC load Line, Frequency response and Amplifier bandwidth

of CE Amplifier

[Ref. No.3: 8.1, 8.4, 8.7-8.12, 8.17, 8.18, 8.26] [Ref. No. 2: 7.1-7.7, 7.10, 8.7, 8.8]
[Ref.No.4 : 7.6]

7: Operation Amplifiers and Logic Gates [8L]

The Differential Amplifier;Op-Amp Characteristics: Input and Output impedance, Input bias

current, Input offset current, Input and Output offset voltages.

Op-Amp as Inverting and Non-Inverting amplifier.

[Ref. No.4:17.2, 18.4][Ref. No.5: 8.1-8.3] [Ref. No.6: 3.2]

Binary number system, Binary to Decimal and Decimal to Binary conversion.

Boolean Algebra, Basic logic gates: OR, AND, NOT, NOR, NAND, and EX-OR gates.

De Morgan's Theorems, NAND and NOR gates as universal building blocks in logic circuits.

[Ref. No.3: 26.3-26.6, 26.20, 26.12-26.17, 26.22]

Experiments: (Minimum Six: Three from each section)

I. Electricity and Magnetism

(1) Step Response of RC circuit Charging and discharging of a capacitor

(2) Response of LR and CR circuits to A.C. using phasor diagrams

(3) de Sauty's capacitance bridge

(4) Self inductance of a coil using Maxwell's inductive bridge

(5) Mutual inductance of two coils in series

II. Electronics

(1) Half wave and Full wave rectifier using Junction Diode, Load regulation characteristics.
(2) Zener Diode Regulation
(3) C.E. Amplifier: Gain v/s Load, Input and Output Impedance
(4) Op-Amp: Input and Output Impedance
(5) Inverting and Non-inverting Op-Amp
(6) Verification of De Morgan Law's and Boolean Identities (Construction using Gates)
(7) NAND and NOR gates as universal building blocks.

References:

I. Electricity and Magnetism

1. Halliday David, Resnik Robert and Walker Jearl, Fundamentals of Physics, John Wiley & Sons, Inc., 6th Edition (2003)
2. Vasudeva D. N., Fundamentals of Magnetism and Electricity, S. Chand & Company Ltd., 12th Revised Edition (1999)
3. Young Hugh D., Freedman Roger A. and Ford A. Lewis, Sears and Zemansky's University Physics with Modern Physics, Addison-Wesley Publishers, 13th Edition(PDF) (2012)
4. Fewkes J. H. and Yarwood John, Electricity, Magnetism and Atomic Physics, Volume I, Oxford University Press Ltd., 10th Impression (1991)
5. Purcell Edward M., Electricity and Magnetism-Berkeley Physics Course,Volume 2, Mcgraw-Hill Book Company(PDF)

II. Electronics

1. Bhargava N. N., Kulshreshtha D. C. and Gupta S. C., Basic Electronics and Linear Circuits, Tata McGraw Hill Education Private Ltd., 54th Reprint (2010)
2. Mottershed Allen, An Introduction to Electronics Devices and Circuits, Prentice-Hall of India Private Ltd., Eastern Economy Edition (2008)
3. Metha V. K. and Mehta Rohit, Principles of Electronics ,S. Chand & Company, Multicolour Revised Edition (2008)
4. Malvino A. P., Electronic Principles, Tata McGraw Hill Education Private Ltd., 5th Edition (1996)
5. Bapat Y. N., electronic Circuits and Systems, Tata McGraw-Hill Publishing company Limited New Delhi, First Reprint (1993).
6. Choudhury D. Roy, Jain Shail, Linear Integrated circuits, New Age International (P) Ltd., Twelfth Reprint, (1998).

Annexure III

List of Examiners

1. Dr. Swati Pawar, Dhempe College, Panaji
2. Dr. Satish Keluskar, PES College, Ponda
3. Mrs. Mandakini Rane, PES College, Ponda
4. Mr. Narayan Bandodkar, Govt. College of Arts, Science and Commerce, Quepem
5. Mr. Rajendra, Carmel College, Nuvem
6. Dr. Shirish Kamat, Govt. College of Arts, Science and Commerce, Quepem
7. Ms. Pearl Desouza, Carmel College Nuvem
8. Dr. Girish Kundaikar, PES College, Ponda
9. Dr. Efram Desa, Carmel College, Nuvem
10. Mr. Manoj Salgaonkar, St. Xavier College, Mapusa
11. Mr. Jason Joseph, Govt. College of Arts, Science and Commerce, Khandola
12. Mr. Benedict Soares, St. Xavier College, Mapusa