

**K.L.E. Society's**

**R. L. Science Institute (Autonomous), Belagavi**

**DEPARTMENT OF PHYSICS**

**B.Sc. (Basic/Honors) PHYSICS**

**DSCC & OEC Syllabus**

**(NEP)**

**of**

**Undergraduate Programme**

**B.Sc. I & II Semester**

**w.e.f Academic year 2021-22**

**PHYSICS****I - SEMESTER****21PH101 - Mechanics and Properties of Matter****Credits: 04****Total Teaching Hours = 56****Course Outcomes (COs)**

After successful completion of the course, the student,

CO1 :Will learn about conservation laws in different frames of reference

CO2 :Will know how g can be determined experimentally and derive satisfaction.

CO3 :Will come to know how various elastic moduli can be determine.

CO4 :Will measure surface tension and viscosity and appreciate the methods adopted.

**Unit I: Conservation Laws**

**Linear Momentum:** Law of conservation of linear momentum (statement). Law of conservation of linear momentum for a system of particles. Centre of mass & Expressions for position vector, velocity, acceleration & force of centre of mass. Distinction between laboratory frame of reference and centre of mass frame of reference. Concept of elastic and inelastic collisions. Law of conservation of linear momentum for a system of particles. Derivation of final velocities in case of elastic collision in (i) laboratory frame of reference. (ii)centre of mass frame of reference. Derivation of final velocities in case of inelastic collision in (i) laboratory frame of reference. (ii)centre of mass frame of reference. Conservation of momentum in case of variable mass (derivation).

**Problems**

**Angular Momentum:** Basics of angular momentum and torque, Angular momentum for a system of particles, its relation to angular velocity and torque. Conservation of angular momentum (derivation). Law of conservation of angular momentum with examples. Concept of work & power in terms of line integral. Law of conservation of energy. Work energy Principle.

**Problems****14 Hrs****Unit II: Gravitation and Relativity**

**Gravitation:** Newton's law of gravitation. Gravitational potential and field intensity due to spherical distribution of matter (Solid sphere only). Derivation of Kepler's laws of planetary motion from Newton's laws (Vector method) Gravitational waves (Overview)

Concept of Satellite, Gravitational potential energy. Derivation for binding energy of satellite. Escape velocity, Orbital velocity-Artificial Satellite : Geostationary satellites and polar orbit satellite with different types of orbits (Qualitatively). Concept of weightlessness, Basic ideas of GPS and NAVIC.

Problems.

**Relativity:** Inertial and non inertial frames of references. Newtonian principle of relativity. Derivation of Galilean transformation equations. Postulates of special theory of relativity. Lorentz transformation equations. Length contraction. Time dilation. Addition of velocities. Derivation of variation of mass with velocities. Derivation of Einstein's mass- energy relation

Problems

**14 Hrs**

**Unit III: Elasticity**

Origin of elastic forces, stress-strain diagram, elastic limit and Hook's law. Moduli of elasticity of isotropic materials. Poisson's ratio, Mention of relation connecting them (Qualitative). Bending of beams; Derivation of Young's modulus by bending of beam supported at its ends and loaded at middle. Theory of light cantilever loaded at the free end. Expression for torsional couple per unit twist. Torsional pendulum.

Problems

**Rigid Body Dynamics**

**Moment of Inertia:** Review of theorems of Moment of Inertia. Derivation of expressions for moment of inertia: (i) rectangular lamina (discuss different cases) (ii) circular disc (about Perpendicular axis). M. I. of annular ring about an axis passing through center of gravity and perpendicular to the plane; solid cylinder about its axis (derivation). Theory of Fly Wheel Experiment.

Problems

**14 Hrs**

**Unit IV: Fluid Mechanics**

**Surface tension:** Definition of surface tension. Surface energy, relation between surface tension and surface energy, pressure difference across curved surface example, excess pressure inside spherical liquid drop, angle of contact. Determination of surface tension by Quincke's Method. Effect of temperature, impurity on surface tension. Applications.

**Viscosity:** Streamline flow, turbulent flow, equation of continuity, determination of coefficient of viscosity by Poissulle's method, Stoke's method (with derivation). Effect of temperature and pressure on viscosity. Applications.

Problems.

**14 Hrs**

**SUGGESTED ACTIVITIES:**

1. Students can try and understand conservation of energy in every day examples. For example:
  - i) What happens in solar conservation panels
  - ii) Pushing an object on the table it moves
  - iii) Moving car hits a parked car causes parked car to move.

In these cases, energy is conserved. How? Understand and verify if possible
2. Students can try and understand the inertial and non-inertial frames of reference in every day examples.
3. Students can perform experiments to understand and determine the acceleration due to gravity.
4. Students can watch you tube videos to understand the concepts of time dilation and length contraction.
5. Arrange a steel spring with its top fixed with a rigid support on a wall and a meter scale along side. Add 100 g load at a time on the bottom of the hanger in steps. This means that while putting each 100g load, we are increasing the stretching force by 1N. Measure the extension for loads up to 500g. Plot a graph of extension versus load. Shape of the graph should be a straight line indicating that the ratio of load to extension is constant. Go for higher loads and find out elastic limit of the material. Repeat the above experiment with rubber and other materials and find out what happens after exceeding elastic limit. Plot and interpret.
6. Moment of inertia is an abstract concept. It simply gives a measure of rotational inertia of a rigid body and it is proportional to the product of the square of radius,  $r$  of the body and its mass,  $m$ . Students by referring to websites, can construct and perform simple

experiments to verify that  $MI \propto mr^2$ .

7. Measure surface tension of water and other common liquids and compare them.
8. Collect a set of different liquids and measure their viscosity.

\*For all the above activities, students can make simple charts, models and give seminar talks wherever possible.

### REFERENCE BOOKS:

- 1) Fundamentals of Physics- R.Resnik, D. Halliday and Walker; Wiley 6ed(2001)
- 2) A text Book on Sound (II – Edition) – Brijlal, Subramanyam , Vikas Publishing house, New-Delhi,1977
- 3) Physics-Classical and Modern, FJ Keller, E Gettys and J J Skove, McGraw Hill Second Revised Edition(1993)
- 4) Classical Mechanics-K N Shrinivasa Rao, Universities Press- Orient Longman (2003 ed)
- 5) Concepts of Physics Vol (1)-H C Verma, Bharathi Bhavan Publishers, 2004 Edition
- 6) University Physics- F W Sears, M W Zemansky & H D Young, Pearson Education First ed.(2014)
- 7) Mechanics- J C Upadhaya, Himalaya (2014 ed)
- 8) Mechanics- Berkeley Physics Course Vol(1)- SI units Charles Kittel McGrawHill Education (India) 2e (2011).
- 9) Elements of Properties of matter – D S Mathur, S.chand(GL) 7 Co Ltd,Dehi 1ed(2010)
- 10) Properties of Matter - Brijlal & Subramanyam, S Chand & Co, (2002)
- 11) Newtonian Mechanics- A P French, Nelson & Sons UK, (1971)
- 12) Mechanics & Thermodynamics, G Basavaraju & Dipan Ghosh, McGrawHill Education India) 1ed (1985)
- 13) A treatise on general properties of matter, Sengupta and Chatterjee, New Central Book Agency Pvt Ltd, Calcutta (7<sup>th</sup> Revised edition -2010)
- 14) Perspectives of Modern Physics, Arthur Beiser, Mc- Graw Hill;
- 15) Introduction to Special Theory of Relativity, Rober Resnick, John Wiley and Sons First Edition
- 16) Special Relativity, A P French, MIT, w.w. Norton and Company First Ed (1968)
- 17) Concepts of Modern physics McGraw hill Education(India) Pvt Ltd;6<sup>th</sup> ed (2000)
- 18) Principles of Modern Physics, A.P. French, John Wiley, London (1958).
- 19) Modern Physics - S.N. Ghoshal, Part 1 and 2 S. Chand and Company (1996).
- 20) Advanced analytical dynamics : Dynamic of rigid body, Utpal Chatterjee, Academic Publishers, first edition,(2016).
- 21) Theory of mechanics, kinematics and dynamics: V. R. Gupta, I K International publishing house Pvt. Ltd, (2013).
- 22) Dynamics of Rigid Body : A. K. Sharma, Discovery Publishing Group,(2007).
- 23) Properties of matter: R. Murugesan, S Chand & Co Ltd Publication.
- 24) Theory of Elasticity: P. N. Chandramouli, Yes Dee publishers(2017).
- 25) An introduction to the theory of elasticity: R. J. Atkin & N. Fox, Dover Publications Inc. (2005).
- 26) Theory of elasticity: Dr. Sadhu Singh, Khanna publishers, (1978).
- 27) B.Sc Physics - C. L. Arora.
- 28) Mechanics, S P Taneja, R Chand & Co New Delhi

## **21PH102: PHYSICS PRACTICAL**

### **Course Outcomes:**

After successful completion of the course, the student,

**CO1:** Will get hands on experience of different equipment.

**CO2:** Will see the difference between simple and torsion pendulum and their use in the determination of various physical parameters.

**CO3:** Will measure surface tension and viscosity and appreciate the methods adopted.

**CO4:** Will know how  $g$  can be determined experimentally and derive satisfaction.

**CO5:** Will measure Moment of Inertia of Fly wheel and verify perpendicular and parallel axis theorem for Circular disc.

**CO6:** Will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)

**CO7:** Will Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.

### **List of Experiments:**

1. Moment of Inertia of Fly wheel.
2. Flat Spiral Spring.
3. Young's modulus ( $Y$ ) by Cantilever- Load v/s depression graph.
4. Young's modulus ( $Y$ ) by uniform bending- Load Vs depression graph.
5. Bar pendulum- determination of  $g$
6. Modulus of rigidity by Torsional pendulum
7. Verification of parallel axis theorem of Moment of Inertia.
8. Verification of perpendicular axis theorem of Moment of Inertia.
9. To determine rigidity modulus by dynamic method.
10. Determination of surface tension by Quincke's method.
11. Determination of surface tension by capillary rise method
12. Determination of coefficient of viscosity by Stoke's method.

### **Note :**

1. Experiments are of Four hours duration.
2. Minimum of eight experiments to be performed.

### **References:**

1. B Saraf etc, - Physics through experiments, Vikas Publications (2013)
2. D P Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed (1985).
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London.
4. An Advanced Course in Practical Physics , D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, (2002).
5. Practical Physics - M A Hipparagi.
6. BSC, Practical Physics, CL Arora, SChand & Co, New Delhi, (2007) Revised Edition.
7. B.Sc. Practical Physics, Geeta Sanon R. Chand & Co. New Delhi.

**I Semester****OEC: 21PH111- ENERGY SOURCES (OEC)****Credits: 03****Total Teaching Hours = 40****Course Outcomes:**

After successful completion of the course, the student will be able

**CO1:** To understand the need, importance and scope of non conventional and alternate energy resources.

**CO2:** To understand role significance of Renewable energy sources such as Wind, Solar and Tidal Energy.

**CO3:** To understand the role of ocean energy in the Energy Generation.

**CO4:** To get the utilization of Biogas plants and geothermal energy

**CO5:** To understand the environmental impact of hydro power sources

**Unit-I: Non-Renewable energy sources****Introduction**

Energy concept-sources in general, its significance & necessity. Classification of energy sources: Primary and Secondary energy, Commercial and Non-commercial energy, Renewable and Non-renewable energy, Conventional and Non-conventional energy, Based on Origin-Examples and limitations. Importance of Non-commercial energy resources. **04Hrs**

**Conventional energy sources**

Fossil fuels & Nuclear energy- production & extraction, usage rate and limitations. Impact on environment and their issues& challenges. Overview of Indian & world energy scenario with latest statistics- consumption & necessity. Need of eco-friendly & green energy & their related technology. **10Hrs**

**Unit-II : Renewable energy sources****Introduction:**

Need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy Hydroelectricity. **06Hrs**

**Solar energy:**

Solar Energy-Key features, its importance, Applications of solar energy. Solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell -brief discussion of each. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. Merits & demerits of solar energy. **08Hrs**

### **Unit-III : Alternative Energy Resources**

#### **Wind and Tidal Energy harvesting:**

Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Ocean Energy Potential against Wind and Solar, Tidal energy characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy. **08Hrs**

#### **Geothermal and Hydro energy:**

Geothermal Resources, Geothermal Technologies.

Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Carbon captured technologies, cell, batteries (SOFC) and power consumption. **06Hrs**

#### **Suggested Activities:**

1. Demonstration of on Solar energy, wind energy, etc, using training modules at Labs.
2. Conversion of vibration to voltage using piezoelectric materials.
3. Conversion of thermal energy into voltage using thermoelectric (using thermocouples or heat sensors) modules.
4. Project report on Solar energy scenario in India
5. Project report on Hydro energy scenario in India
6. Project report on wind energy scenario in India
7. Field trip to nearby Hydroelectric stations.
8. Field trip to wind energy stations like Chitradurga, Hospet, Gadag, etc.
9. Field trip to solar energy parks like Yeramaras near Raichur.
10. Videos on solar energy, hydro energy and wind energy.

#### **Reference Books:**

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).  
[http://en.wikipedia.org/wiki/Renewable\\_energy](http://en.wikipedia.org/wiki/Renewable_energy)

**PHYSICS**  
**II – SEMESTER**

**DSC PHY 21PH201: Electricity and Magnetism**

**Credits: 04**

**Total Teaching Hours = 56**

**Course Outcomes (COs)**

After successful completion of the course, the student will,

CO1: Know the vocabulary and concept of physics as it applies to Principal of Electric Field.

CO2: Apply Gauss's law of electrostatics to solve a variety of problems.

CO3: Describe the magnetic field produced by magnetic dipoles and electric currents.

CO4: Explain gradient, curl & divergence concepts and Maxwell laws to articulate the relationship between electric and magnetic fields.

**Unit I: Dielectrics**

Dielectric Sphere in a uniform field, work and energy in electrostatics. Electric polarization, Gauss law in Dielectrics and electric displacement. Boundary conditions at a surface separating two dielectric media (derivation). Relation between electric displacement 'D', Electric field 'E' and polarization 'P'. Atomic polarisability, electric susceptibility, Relation between electric constant and electric susceptibility. State and explain Coulomb's law in dielectric medium. Expression for mechanical stress on surface of charged conductor. Application to electrified soap bubble (qualitative only). Expression for Electrostatic energy in a medium surrounding charged conductor. Electrical images (qualitative), classification of dielectrics. Capacitance of a parallel plate capacitor and cylindrical capacitor with dielectric.

Problems

**14 Hrs**

**Unit II : Current Electricity and Magnetism**

**Current Electricity** : Statement of Biot-Savart's law, Derivation of expression for magnetic field due to straight conductor carrying current, mention of expression for magnetic field along the axis of a circular coil and discussion of special cases. Helmholtz Galvanometer-Principle, construction and working. Ampere's circuital law-Statement, proof and its application to derive the magnetic field due to a solenoid and toroid.

**Transient Currents**

Theory of growth and decay of current through RL circuit and charging and discharging of capacitor through RC circuit. Measurement of high resistance by leakage method.

Problems

**Magnetic Properties**

Introduction, Permeability and magnetic susceptibility. Types of magnetic materials( Dia, Para, Ferro, Anti-ferro and Ferri), Magnetic hysteresis and its applications.

**14 Hrs**

**Unit III : Alternating Current**

**Alternating Current**

Operator  $j$ , Argand diagram, LCR series circuit-Expression for current, impedance and phase(using  $J$  operator method). Condition for resonance frequency, band width, Selectivity, quality factor and their relation (qualitative). LCR parallel circuit-Expression for admittance and

condition for resonance (using J operator method). Comparison between series and parallel resonance circuits,

Problems

### **Dynamics of Charged particles**

Charged particles in a uniform (static) electric field applied along the direction of the particle motion, energy acquired, motion of a charged particle in uniform transverse electric field. Charged particle in a constant uniform magnetic field.

Problems

**AC Bridges:** Introduction, Owens's Bridge, Maxwell's Bridge and Wien's Bridge. **14 Hrs**

## **Unit IV: Electromagnetic Theory**

### **Vector Analysis**

Introduction. Del Operator, Gradient of scalar and its physical significance. Divergence of vector and its physical significance. Curl of vector and its physical significance. Vector Identities, Vector integration; line, surface & volume integrals of a vector field. Gauss Divergence theorem & Stokes theorem (statement).

### **Maxwell's Electromagnetic Theory:**

Derivation of Maxwell's equations in differential form. Mention of Maxwell's equations in integral form and their physical significances. Derivation for general plane wave equation in free space. Transverse nature of radiation. Derivation of Poynting's theorem.

**14 Hrs**

### **REFERENCE BOOKS:**

- 1) Electricity and Magnetism by Brij Lal and N Subrahmanyam, Rathan Prakashan Mandir, Nineteenth Edition, 1993.
- 2) Electricity and Magnetism - R Murgeshan.
- 3) Principles of Electronics by V K Mehta and Rohit Mehta, S Chand & Company, Eleventh Edition, **2008**.
- 4) Fundamentals of Magnetism & Electricity: D. N. Vasudeva, S Chand Publication, (2011).
- 5) Electricity & Magnetism: B. S. Agarwal, Kedarnath Ramnath Publication (2017).
- 6) Electricity & Magnetism: A. N. Matheev, Mir Publishers Moscow, (1987).
- 7) Electricity and Magnetism with Electronics: Dr. K.K.Tiwari, S.Chand Publications (1995).
- 8) Fundamentals of electric circuit theory: Dr. D. Chattopadhyay & Dr. P. C. Rakshit, S. Chand Publications, 7<sup>th</sup> Rev. Edn. (2006).
- 9) Feynman Lecture series, VolIII, R P Feynman et al, Narosa Publishing House, New Delhi
- 10) Electricity & Magnetism, D L Sehgal, K L Chopra, N K Sehgal, S Chand & Co, Sixth Edition, (**1988**).
- 11) Electricity & Electronics, D C Tayal, Himalaya Publishing House, Sixth Edition (**1988**).
- 12) Basic Electronics & Linear Circuits, N N Bhargava, D C Kulshrestha & SC Gupta, TMH Publishing Company Limited, 28<sup>th</sup> Reprint, (**1999**).
- 13) Fundamentals of Physics by Halliday, Resnick and Walker, Asian Books private Limited, New Delhi, 5<sup>th</sup> Edition, (**1994**).
- 14) Introduction to Electrodynamics by D J Griffiths Pearson Education (**2015**).

## **21PH202: PHYSICS PRACTICAL**

### **Course Outcomes:**

After successful completion of the course, the student,

**CO1:** Will get hands on experience of different electrical equipment.

**CO2:** Will have achieved the ability to Choosing testing and experimental procedures on different types of electrical circuit and analyze their operation with different operating conditions.

**CO3:** Will learn fixing units, tabulation of observations, analysis of data (graphical/analytical)

**CO4:** Apply knowledge of electricity and magnetism to explain natural physical processes and related technological advances.

### **List of Experiments:**

1. High resistance by leakage method
2. Time constant of RC circuit by charging and discharging method.
3. Calibration of Ammeter using Helmholtz Galvanometer
4. LCR series and parallel resonance circuit
5. Owen's Bridge
6. Use of CRO to find voltage, frequency and phase.
7. L & C by Equal Voltage Method.
8. Verification of maximum Power Transfer Theorem
9. Determination of Magnetic Field along the axis of coil and permeability of free space.
10. Determination of Dielectric Constant.
11. Determination of frequency of AC using Sonometer.
12. Self Inductance by Rayleigh's method

### **Suggested Activities:**

1. Student can perform experiment of dielectric constant using different substances.
2. Learn about household electrical connection terminals: Live, neutral and ground and voltage between the terminals. Role of earthing and safety measures.
3. Learn about electrical appliances which work with AC and DC electricity
4. Learn about types of resistors and their colour codes and types of capacitors(electrolytic and non-electrolytic)
5. Prepare a small project report on street lighting and types of electrical bulbs.
6. Learn the measurement of electric current using tangent galvanometer.
7. Prepare a small project report on production of magnetic field: Permanent magnets, electromagnets and superconducting magnets.

8. Learn the principle of working of a Gauss meter to measure magnetic field.
9. Model the earth's magnetic field with a diagram. Explain the effect of tilt of the earth's axis and reasons for the change in the tilt of the earth's axis over thousands of years.

\*For all the above activities, students can make simple charts, models and give seminar talks wherever possible.

**References:**

1. Physics through experiments. B Saraf etc,- Vikas Publications (2013).
2. D P Khandelwal – A Laboratory Manual of Physics for Undergraduate Classes, Vikas Publications First ed (1985).
3. Advanced Practical Physics for Students – Worsnop & Flint, Methuen & Co, London.
4. An Advanced Course in Practical Physics , D Chattopadhyay, P C Rakshit, B Saha, New Central Book Agency (P) Limited, Kolkata, Sixth Revised Edition, (2002).
5. BSC, Practical Physics, CL Arora, SChand & Co, New Delhi, (2007) Revised Edition. B.Sc. Practical Physics, Geeta Sanon R. Chand & Co. New Delhi.

**II Semester****21PH211: OPTICAL INSTRUMENTS(OEC)****Credits: 03****Total Teaching Hours: 40Hrs****Course Outcomes:****After learning the course the students will be able****CO1:** To understand the fundamental concepts of reflection, refraction and dispersion of Light.**CO2:** To explain the fundamentals of instruments based on optical phenomenon.**CO3:** To describe the working of optical components in various instruments.**CO4:** To explain the applications of various types of optical components in instruments.**Unit 1: Basics of Optics**

Scope of optics, optical path, laws of reflection and refraction as per Fermat's principle, magnifying glass, Lenses (thick and thin), convex and concave lenses, Lens makers formulae for double concave and convex lenses, lens equation. **10 Hrs**

**Unit 2: Dispersion of light**

Focal and nodal points, focal length, image formation, combination of lenses, dispersion of light: Newton's experiment, angular dispersion and dispersion power. Dispersion without deviation. (Expressions need not be derived, but have to be discussed qualitatively). **10 Hrs**

**Unit 3 : Camera and Microscopes**

Human eye (constitution and working), Photographic camera (principle, construction and working), construction, working and utilities of Simple microscopes, Compound microscope, Electron microscopes, Binocular microscopes

Self study

Experimental determination of magnifying power of a microscope. (Construction part can be discussed through block diagrams) **10 Hrs**

**Unit 4: Telescopes and Spectrometer**

Construction, working and utilities of Astronomical telescopes Terrestrial telescopes Reflecting telescopes, Construction, working and utilities of Eyepieces or Oculars (Huygen, Ramsden's, Gauss) Spectrometer - Construction, working and utilities, measurement of refractive index.

Self study

Telescopes used at different observatories in and outside India. **10 Hrs**

**References:**

1. Optic by A. Ghatak, Tata McGraw Hill.
2. Optics by E. Hecht, Addison Weseley.
3. Fundamentals of Optics by F. A. Jenkins and H. E. White, McGraw Hill, New York.