Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon

1990

'A' Grade
NAAC Re-Accredited
(4th Cycle)

Subject Titles & Course Code

for

Science Core Courses, OE, VEC, IKS_CC Courses

At

F.Y.B.Sc. As per NEP-2020 Pattern

With Effect from

June - 2024

Submitted by Board of Studies (Physics)

F.Y. B.Sc. Course code and titles as per NEP-2020 w.e.f. 2024-25

Subject: Physics				
Course	Course Type	Course code	Course Title	Credits
Semester-I				
DSC-1	DSC	PH-111	Physics Principles and Applications-I	2
DSC-2	DSC	PH-112	Laboratory-I	2
Semester-II				
DSC-3	DSC	PH-121	Physics Principles and Applications-II	2
DSC-4	DSC	PH-122	Laboratory-II	2

- Subject Basket for Generic / Open Elective Course (GE/OE)

Offered by Faculty of Science & Technology

To be Opted by Humanities / Commerce & Management Students

Year / Level	Sem.	Course	Course Code	Course Title	No of Credits	Offering Department
Year-1	Sem-I	OE-1	PH-114	Materials in today's world	2	Physics
Level - 4.5	Sem-II	OE-2	PH-124	Energy	4	Physics

PH-111

Physics Principles and Applications-I

Course Code: PH-111	**Course Category: Core Courses (DSC)** (To be chosen compulsorily from faculty other than that of the Major)
Course Title: Physics Principles and Applications-I	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: **20 Marks**	**University Assessment (UA):** **30 Marks**

Course Objectives:

- To impart to the students, knowledge about the basic physics principles in the field of current electricity, electric circuit analysis, electromagnetism and optics,
- To discuss the applications which are based on these basic principles,
- To nurture curiosity in students about Physics and its applications

Course Outcomes:

On completion of the course students will be able to:

- Understand the basic physics principles in the field of current electricity, electric circuit analysis, electromagnetism and optics,
- Apply these principles in understanding applications of these principles,
- Apply the knowledge gained, in solving some simple problems based on these principles,
- Analyze a problem/situation to understand the basic physics principles involved in it.

Course Contents

UNII-I: CURRENT ELECTRICITY (08 Hours, 08 Marks)

- Electrical Current: an electrical current, unit of electrical current, the direction of flow of charges and conventional current flow (Problems on concept of an average current and instantaneous current)
- Model of Conduction in Metals: the drift velocity of charges moving through ametal, concept of gauge of a wire and its significance (Problem on finding driftvelocity), concept of the vector current density (Problem on finding current density), operation of an incandescent lamp.
- Resistivity and Resistance: Differentiate between resistance and resistivity. conductivity (Discussion on why copper is the most suitable metal for making awire for conduction of electric current), a resistor, relationship between resistance of a resistor and its length, cross-sectional area, and resistivity, relationship between resistivity and temperature, (Problem on finding the resistance as a function of temperature)
- Electrical Energy and Power: electrical power in terms of the voltage and the current, the power dissipated by a resistor in an electric circuit (Problems on calculating electrical power for an electric appliance, energy efficiency and cost effectiveness of appliances)

Reference: OPENSTAX University Physics, Volume 2

UNII-II: ELECTRIC CIRCUIT ANALYSIS (08 Hours, 08 Marks)

- Concept of DC and AC, Introduction to circuit elements: Independent voltage andcurrent source, Dependent voltage, and current source,
- Concept of Nodes, Branches and Loops (Problems on finding the number of nodes, branches and loops; identifying series and parallel branches)
- Kirchoff's Current and Voltage law (Problems on finding current and voltages in circuits using KCL and KVL)
- Series resistors for voltage division and parallel resistors for current division (Problems on finding volage and current in circuits with series and parallel combination of resistors)
- Thevenin's Theorem (Problem on finding the Thevenin's equivalent circuit andusing that, finding current through load)
- Norton's Theorem (Problem on finding the Norton's equivalent circuit)
- Maximum Power Transfer Theorem (Proof and Problem based on it)

Reference: Fundamentals of Electric Circuits by Charles Alexander, Mathew Sadiku

UNII-III: ELECTROMAGNETISM (07 Hours, 07 Marks)

- Faraday's Law (Problem to determine the magnitude of induced emf and current through a closed coil due to changing magnetic flux through it)
- Lenz's Law: Example demonstrating that when current is turned on in a vertical solenoid the ring put it in gets fired,
- Motional emf: Magnitude of motional emf, metal rod rotating in magnetic field, a rectangular coil rotating in a magnetic field: basis of electric generator,
- Working of electric generators
- Mutual Inductance: Examples: Desirable in transformer, undesirable in cloth'sdryer
- Self-Inductance and Inductors: Example of metal detector system(Problems on self and mutual inductance)

Reference: OPENSTAX University Physics: Volume 2

UNIT 4: OPTICS (07 Hours, 07 Marks)

- Image Formation by Reflection—The Mirror Equation (Problem on solar electric generating system)
- Images Formed by Refraction: Refraction at a Plane Interface—Apparent Depth,Refraction at a Spherical Interface
- Thin Lenses: Ray Tracing and Thin Lenses, Image Formation by Thin Lenses, The Lensemaker's equation (Problems on image formation by converging lens, diverging lens and an image ofan image: Reference: University Physics by Young and Freedman)

Reference: OPENSTAX University Physics: Volume 3

- Cameras, Camera lenses: focal length, f-number, zoom lenses and projectors
- The Eye: Defects of vision and corrections (Problems on farsightedness and nearsightedness)
- The magnifier, Microscopes and telescopes

Reference: Principles of Physics by Holliday and Resnik

List of Reference Books:

1. *OPENSTAX University Physics, Volume 2 (https://openstax.org/details/books/university-physics-volume-2)
2. Fundamentals of Electric Circuits by Charles Alexander, Mathew Sadiku
3. *OPENSTAX University Physics: Volume 3 (https://openstax.org/details/books/university-physics-volume-3)
4. Principles of Physics by Holliday and Resnik
5. A Textbook of Electrical Technology by B L Theraja & A K Theraja, S Chand Publication
6. Electricity & Magnetism by D C Tayal, Himalaya Publishing House
7. Electricity and Magnetism by Edward M Purcell, McGraw-Hill Education
8. Fundamental Electricity and magnetismby F. Kip, Mc Graw hill

(* OpenStax has created peer-reviewed, openly-licensed textbooks, which areavailable freely in digital formats)

PH-112
LABORATORY-I

Course Code: PH-112	**Course Category: Core Courses (DSC)**
Course Title: Laboratory-I	**Type: Laboratory**
Total Contact Hours: 60 (4/week)	**Course Credits: 02**
College Assessment (CA) Marks: **40 Marks**	**University Assessment (UA):** **60 Marks**

Course Objectives:

- To impart to the students, practical knowledge about the basic physics principles in the field of current electricity, electric circuit analysis, electromagnetism and optics,
- To demonstrate practical aspects of the theory, they learn in the course PH-111,
- To nurture curiosity in students about Physics and its applications

Course Outcomes:

On completion of the course students will be able to:

- Demonstrate basic laboratory skills essential in Physics Laboratory,
- Understand the specifications of laboratory equipment and their significance,
- Apply the basic physics principles, learnt in the course PH-111, in the laboratory.

PH-112
LABORATORY-I

List of Laboratory Practicals

1. Study of Analog/Digital Voltmeter, Ammeter (AC, DC ranges and least count).
2. To use a Multimeter for measuring:
   i) Resistances
   ii) A.C. and D.C. Voltages
   iii) D.C. Current (in a simple circuit)
   iv) Checking electrical fuses
3. Verification of Kirchhoff's laws.
4. To verify Thevenin's theorem.
5. To verify Norton's theorem.
6. To verify Maximum Power Transfer Theorem (Note: Use personal computer/Laptop for graph plotting is necessary).
7. To verify Joule's law.
8. To find electrical energy consumed in a circuit using Joule's law.
9. To determine Self-Inductance of a Coil by Rayleigh's Method.
10. To determine a low resistance by Carey Foster's Bridge.
11. Electric billing with energy meter.
12. Frequency of A.C. using vibrating wire and magnet.
13. To determine efficiency and turns ratio of transformer.
14. To determine resistances of 3 different gauges copper wires of 10 cm length by using $R = \rho \frac{l}{A}$ and verify it with multimeter (Given: resistivity of copper $\rho = 1.724 \times 10^{-8}$ ohm m)
15. Determination of time constant of L-R circuit.
16. To determine the current sensitivity and charge sensitivity of a ballistic galvanometer by the steady deflection method.

17. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
18. Find (Theoretically and Practically) the location, orientation and magnification of the image for a 3.0 cm length object at each of the following positions in front of a convex lens of focal length 10.0 cm. (a) d_o=30.0 cm, (b) d_o=20.0 cm and (c) d_o=5.0 cm. (Ref. Page no.77-79 of Openstax University Physics Volume 3).
19. To determine the mutual inductance of two coils by Absolute method.

*1. Students should perform at least ten experiments from the following list.

2. More Practicals can be added to this list as and when necessary, with the permission of the Chairman, BOS (Physics)

PH-121

Physics Principles and Applications-II

Course Code: PH-121	**Course Category: Core Courses (DSC)** (To be chosen compulsorily from faculty other than that of the Major)
Course Title: Physics Principles and Applications-II	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: **20 Marks**	**University Assessment (UA):** **30 Marks**

Course Objectives:

- To impart to the students, knowledge about the basic physics principles in the field of gravitation, fluids, sound and semiconductors,
- To discuss the applications which are based on these basic principles,
- To nurture curiosity in students about Physics and its applications

Course Outcomes:

On completion of the course students will be able to:

- Understand the basic physics principles in the field of gravitation, fluids, sound and semiconductors
- Apply these principles in understanding applications of these principles,
- Apply the knowledge gained, in solving some simple problems based on these principles,
- Analyze a problem/situation to understand the basic physics principles involved in it.

Course Contents

UNIT-I: GRAVITATION **(08 Hours, 08 Marks)**

- Newton's law of Gravitation,
- Experiment by Cavendish to determine G,
- Concept of weight (Problem on weight of lander on Mars/other planet and acceleration due to gravity on Mars/other planet),
- Gravitational potential energy (Problem on minimum speed to lift projectile to certain height above the Earth and then to make it escape from the Earth completely)
- The motion of satellites: circular orbits (Problem on putting a satellite of given mass into a circular orbit of given radius: Calculation of speed, period, radial acceleration, work done for a satellite projected: Reference: University Physics by Young and Freedman; Problem on the International Space Station to determine the orbital speed and period for the International Space Station (ISS), Reference: OPENSTAX University Physics, Volume I),
- Concept of black hole (Problem on finding the event horizon)

Reference:
University Physics by Young and Freedman

OPENSTAX University Physics, Volume 1

UNIT II: FLUIDS **(08 Hours, 08 Marks)**

- Pressure in fluid, variation with depth (Problem on finding the average pressure and average force experienced by a dam)
- Pascal's Principle and Hydraulics: Pascal's principle, applications of Pascal's principle, relationships between forces in a hydraulic system (Problem on the automobile hydraulic system)
- Archimedes' Principle and Buoyancy,
- Bernoulli's Equation: Bernoulli's equation, Bernoulli's equation and conservation of energy, Bernoulli's principle from Bernoulli's equation, calculations using Bernoulli's principle, Applications of Bernoulli's principle: Entrainment, Calculating Pressure: (Problem on a Fire Hose Nozzle to calculate pressure needed, velocity of water at the outlet etc.)
- Surface tension (Concept, factors affecting surface tension and applications)

Reference: OPENSTAX University Physics, Volume 1

Unit III: SOUND (07 Hours, 07 Marks)

- Sound Waves: Sound waves as pressure fluctuations, Mathematical description of sound waves (Reference: Young and Freedman)
- Speed of sound in fluid, solid and gas, example of SONAR (Problem to find speed of sound in water), Ultrasonic imaging, Sound intensity (Problems on finding intensity, average acoustic power for required sound intensity),
- Decibel scale,
- Organ pipes and wind instruments,

Reference: University Physics by Young and Freedman

Unit IV: SEMICONDUCTORS AND DEVICES (07 Hours, 07 Marks)

- Semiconductors Fundamentals: Atomic Structure, Energy level diagram for an atom, Crystals, Energy band diagram for a crystal, Concept of hole, doping, energy band diagram for p-type and n-type materials,
- p-n junction: formation, depletion region, energy diagram, forward and reverse bias, I-V characteristics of p-n junction
- Types of diodes: switching or rectifying, Zener, Schottky, varactor, LED, photodiode: Construction, Symbol, working and applications

Reference: Semiconductor Devices: Theory and Application by James M. Fiore

List of Reference Books:

1. University Physics by Young and Freedman
2. OPENSTAX University Physics, Volume 1 (https://openstax.org/details/books/university-physics-volume-1) (OpenStax has created peer-reviewed, openly-licensed textbooks, which are available freely in digital formats)
3. Semiconductor Devices: Theory and Application by James M. Fiore (https://batch.libretexts.org/print/Letter/Finished/eng-25302/Full.pdf) (This book is freely available for reading, printing via the Open Education Resource (OER) LibreTexts Project (https://LibreTexts.org))
4. Principles of Physics by Holliday and Resnik

5. University Physics by F. W. Sears, M. W. Zemansky and H. D. Young, Addison Wesley
6. Mechanics Berkeley Physics course, V-1: Charles Kittel, et. al., Tata McGraw Hill.
7. Engineering Mechanics by Basudeb Bhattacharya, Oxford University Press,
   PRINCIPLES OF
8. Principles of Electronics by V.K. MEHTA, ROHIT MEHTA, S. CHAND & COMPANY,
9. A Textbook of Applied Electronics by R. S. Sedha, S Chand & Company, New Delhi.
10. Basic Electronics (Solid State) by B.L. Thereja, S. Chand &Company, New Delhi,
11. Basic Electronics by G. B. Grob, McGraw Hill Book Co. New York

PH-122
LABORATORY-II

Course Code: PH-122	**Course Category: Core Courses (DSC)**
Course Title: Laboratory-II	**Type: Laboratory**
Total Contact Hours: 60 (4/week)	**Course Credits: 02**
College Assessment (CA) Marks: **40 Marks**	**University Assessment (UA):** **60 Marks**

Course Objectives:

- To impart to the students, practical knowledge about the basic physics principles in the field of gravitation, fluids, sound and semiconductors,
- To demonstrate practical aspects of the theory, they learn in the course PHY-121,
- To nurture curiosity in students about Physics and its applications

Course Outcomes:

On completion of the course students will be able to:

- Demonstrate basic laboratory skills essential in Physics Laboratory,
- Understand the specifications of laboratory equipment and their significance,
- Apply the basic physics principles, learnt in the course PHY-121, in the laboratory.

PH-122
LABORATORY-II

List of Laboratory Practicals

1. Calculation of errors from given data.
2. Measurements of length (or diameter) using vernier calliper, screw gauge and traveling microscope.
3. Determine the acceleration due to gravity 'g' by an object falling freely using Kinematic equation.
4. To determine 'g' by Bar Pendulum.
5. To determine 'g' by Kater's Pendulum.
6. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of 'g'
7. To determine the Moment of Inertia of a Disc.
8. To determine the Moment of Inertia of a Flywheel.
9. Determination of coefficient of viscosity of water by Poiseuille's method.
10. To determine surface tension by Jaeger's method.
11. Verification of Bernoulli's theorem.
12. To determine the surface tension of a liquid by capillary rise method.
13. To determine velocity of sound by resonance tube.
14. To determine velocity of sound by Kundt's tube.
15. To determine the energy band gap of a semiconductor by using PN junction diode.
16. To study the forward bias and reverse bias characteristics of PN junction diode.
17. Study of low voltage half-wave and full-wave rectifier circuits.
18. Study of reverse characteristics of Zener diode.
19. To study the I-V characteristics of three different colour LED (Red, Blue, Green, etc.).

*1. Students should perform at least ten experiments from the following list.

2. More Practicals can be added to this list as and when necessary, with the permission of the Chairman, BOS (Physics)

PH-114
Materials in Today's World

Course Code: PH-114	**Course Category: Open Elective Course (OE)**
Course Title: Materials in Today's World	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: This course is intended to introduce:

- The various states of matter and properties of solid state
- The development of materials over the ages
- The classification of materials and their properties
- Advanced class of materials and their applications

Course Outcomes: On completion of the course students will be able to

- Define the possible states of matter and their basic properties.
- Explain the chronological development that materials have gone through for achieving their present stage and importance of materials in development of human civilization
- Compare and classify materials and explain their properties
- Understand developments in advanced materials and their applications

Course Contents

Unit 1: States of Matter (04 Hours, 04 Marks)

- Overview of the different states of matter: Solid, Liquid, Gas, Plasma,
- Basic properties of solid state: Structural, electrical, optical, magnetic, chemical.

Unit 2: History and Evolution of Materials (06 Hours, 06 Marks)

- Materials: Drivers of human civilization, Development of materials: Stone age, Copper age, Bronze age, Iron age, Explanation with examples to mark this development

Unit 3: Classification of Materials (10 Hours, 10 Marks)

- Metals & Alloys, Non-Metals, Ceramics, Polymers, Composites etc. with examples and applications, Performance, Composition & Structure; Physical and Chemical properties; Processing & Synthesis of various classes of materials

Unit 4: Trends in Advanced Materials (10 Hours, 10 Marks)

- Breakthroughs in Materials Development, overview of Advanced Materials and their applications: Semiconductors, Biomaterials, Smart Materials (Materials of the Future), Nano-structured Materials

Reference Books:

1. Advanced Materials: Classification, properties, applications and processing techniques of composites by Lokesh KS, Prasad P, Grin Verlag
2. Nanotechnology: Principles and Practices by Sulabha K. Kulkarni, Springer
3. Material Science by S. L. Kakani, Amit Kakani. New Age International Publishers.
4. Material Science by G.K. Narula and K.S. Narula, Tata McGraw Hill.
5. Materials Science and Engineering: An introduction by William D. Callister, Jr. and David G. Rethwisch, John Wiley & Sons, Inc.
6. Understanding Materials Science: History, Properties, Applications by Rolf E. Hummel, Springer-Verlag, New York
7. Essentials of Materials Science and Engineering by Donald R. Askeland and Pradeep P. Fulay, Cengage learning, Canada

PH-124
Energy

Course Code: PH-124	**Course Category: Open Elective (OE)** (To be chosen compulsorily from faculty other than that of the Major)
Course Title: Energy	**Type: Theory**
Total Contact Hours: 60 (4/week)	**Course Credits: 04**
College Assessment (CA) Marks: **40 Marks**	**University Assessment (UA):** **60 Marks**

Course Objectives:

- To know about the Indian and World Energy Scenario
- To know about the Renewable and Non-renewable Energy Sources
- To understand the various modes of Energy Storage

Course Outcomes:

On completion of the course students will be able to:

- Understand the availability of Renewable and Non-renewable Energy Sources.
- Understand the significance of renewable energy sources and energy storage.
- Make appropriate choice of energy source depending on usage pattern.

Course Contents

Unit 1: Energy and Energy scenario **(20 Hours, 16 Marks)**

- What is power, what is energy, need of power and energy, applications of energy in day-to-day life, electrical appliances, and their power specifications, energy consumption based on power and time of usage.
- Indian and World Scenario: Pattern of energy consumption in India and the World, Energy needs of growing economy, Pattern of energy production in India and the World, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms.

Unit 2: Non-renewable Energy Sources **(16 Hours, 14 Marks)**

- Fossil Fuel: Coal, Oil, Gas, Nuclear Resources: Indian and world reserves;
- Power plants based on these resources: Thermal Power Plants, Gas based Power plants, Nuclear Power Plants; Comparison of these plants in terms of their pros and cons.

Unit 3: Renewable Energy Sources **(16 Hours, 20 Marks)**

- Hydel Energy, Solar Energy, Wind Energy, Energy from Biomass and biogas, Hydrogen Energy, Fuel Cell: Basic principle of energy production from these sources, advantages, and limitations of renewable energy sources

Unit 4: Energy Storage and Fuel cells **(08 Hours, 10 Marks)**

- Importance of electrical energy storage, batteries: Lead acid battery, Nickel-cadmium battery, introduction to supercapacitors.
- Fuel cells: Basic principle of working, applications, pros and cons of fuel cells, hydrogen storage.

Reference Books:

1. A document by Bureau of Energy Efficiency, India
   Link: https://beeindia.gov.in/sites/default/files/1Ch1.pdf
2. Generation Of Electrical Energy by Gupta B. R. S., Chand & Co Ltd
3. Non-Conventional Energy Sources by G. D. Rai, Khanna Publication.
4. Non-Conventional Energy Resources by B. H. Khan, McGraw Hill Publishers. Aubrecht, Gordon J., Energy, Second Edition, Prentice Hall, 1994.

5. Solar Energy: Principles of Thermal Collection and Storage by S.P. Sukhatme, Tata Mc Graw-Hill
6. Solar energy by M P Agarwal, S Chand and Co. Ltd.
7. Solar Energy: Resource Assessment Handbook by Dr. P Jayakumar, APCTT
8. Introduction to Photovoltaics by J. Balfour, M. Shaw and S. Jarosek, Jones & Bartlett Publishers

WEBSITES FOR REFERENCE

1. http://www.energy.gov Module 4: Fuel cell technology
2. http://www.fuelcelltoday.com Fuel cell basics
3. http://en.wikipedia.org/wiki/Renewable_energy