U. G. 3rd Semester (NEP) in Physics

Major (Theory)

PHS-M-T-3:ELECTRICITY AND MAGNETISM

Marks (Semester End - 40, Internal Assessment – 10)
Theory: (4 Credits) No. of Lectures – 60

Electric Field and Electric Potential:	
Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.	**6 Lectures**
Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torqueon a dipole.	**6 Lectures**
Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Uniqueness theorem (statement) Method of Images and its application to: (1)Plane Infinite Sheet and (2) Sphere.	**10 Lectures**
Dielectric Properties of Matter:	
Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics.	**8 Lectures**
Magnetic Field:	
Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) infinite straight wire, (2) infinite planar surface current(3) Solenoid and (4)Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.	**9 Lectures**
Magnetic Properties of Matter:	
Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. B-H curve and hysteresis.	**3 Lectures**

Electromagnetic Induction:	
Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field.	**5 Lectures**
Transients:	
Growth and decay of currents and voltages in L-R, C-R and L-C-R circuits; electrical oscillations in L-C circuits.	**2 Lectures**
Electrical Circuits:	
AC Circuits: Kirchhoff s laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.	**4 Lectures**
Network theorems:	
Ideal Constant-voltage and Constant-current Sources. Network Theorems: The venin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.	**4 Lectures**
Ballistic Galvanometer:	
Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR.	**3 Lectures**

Reference Books:

- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Undergraduate Physics Companion (Vol-2), S. Pal, 1st edition, Suhrid Prakashani, Kolkata.
- Electricity and Magnetism, E. M. Purcell, 1986, McGraw-Hill Education.
- Elements of Electromagnetics, M. N. O. Sadiku, 2010, Oxford University Press

U. G. 3rd Semester (NEP) in Physics Major (Practical)

PHS-M-P-3: ELECTRICITY AND MAGNETISM

Marks (Semester End - 20, Internal Assessment – 5)
(Lab. Note Book - 05, Viva-Voce-05, Experiment -10)
Practical: (2 Credits) No. of Lectures – 60

List of Equipments:

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances and (e) Checking electrical fuses.
2. To study the characteristics of a series(a) RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De' Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.
8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and(b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer.
13. Determine a high resistance by leakage method using Ballistic Galvanometer.
14. To determine self-inductance of a coil by Rayleigh's method.
15. To determine the mutual inductance of two coils by Absolute method.
16. To study the characteristics of a series LR Circuit.
17. Measurement of the resistance of a mirror galvanometer by the half deflection method and to determine its figure of merit.

Reference Books:

- Practical Physics Vol 1, Vol 2, B. Ghosh, K. G. Majumder, Sreedhar Publisher
- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
- Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning.

U. G. 3rd Semester (NEP) in Physics

Minor (Theory)

PHS-MI-T-3: ELECTRICITY AND MAGNETISM

Marks (Semester End - 30, Internal Assessment – 5)
Theory: (3 Credits) No. of Lectures –45

Electrostatics:	
Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor.	**8 Lectures**
Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.	**6 Lectures**
Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.	**8 Lectures**
Magnetism:	
Magneto statics: Biot-Savart's law and its applications- straight conductor, circularcoil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia, para, and ferromagnetic materials.	**10 Lectures**
Electromagnetic Induction:	
Faraday's Law of electromagnetic induction. Lenz's Law. Self Inductance and Mutual Inductance. Inductance of single coil, Mutual Inductance of two coils. Energy stored in magnetic field	**6 Lectures**
Maxwell's equations and Electromagnetic wave propagation:	
Equation of continuity of current, Displacement current, Maxwell's equations, Pointing vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.	**7 Lectures**

Reference Books:

- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Undergraduate Physics Companion (Vol-2), S. Pal, 1st edition, Suhrid Prakashani, Kolkata.
- Electricity and Magnetism, E. M. Purcell, 1986, McGraw-Hill Education.
- Foundations of Electricity and Magnetism, Basudeb Ghosh, Books & Allied Ltd.

Minor (Practical)

PHS-MI-P-3: ELECTRICITY AND MAGNETISM

Marks (Semester End - 10, Internal Assessment – 5)
Practical: (1 Credit) No. of Lectures –30

List of Equipments:

01. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
02. Ballistic Galvanometer:(i) Measurement of charge and current sensitivity, (ii) Measurement of CDR, (iii) Determine a high resistance by Leakage Method,(iv) To determine Self Inductance of a Coil by Rayleigh's Method.
03. To compare capacitances using De'Sauty's bridge.
04. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
05. To study the Characteristics of a Series RC Circuit.
06. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
07. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
08. To determine a Low Resistance by Carey Foster's Bridge.
09. To verify the Thevenin and Norton theorems
10. To verify the Superposition, and Maximum Power Transfer Theorems
11. Verification of Ohm's law with a tangent galvanometer.
12. Determination of the end corrections of a metre bridge and to measure the value of an unknown resistance incorporating end corrections.

Reference Books:

- Practical Physics Vol 1, Vol 2, B. Ghosh, K. G. Majumder, Sreedhar Publisher
- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

U. G. 3rd Semester (NEP) in Physics

Skill Enhancement Course (SEC)

PHS-SEC-T-3:RENEWABLE ENERGY & ENERGY HARVESTING

Marks (Semester End - 35, Internal Assessment – 10)
Internal Assessment [(Class Test/ Assignment/ quiz etc) - 10]
Theory: (3 Credits) No. of Lectures –30

Fossil fuels and Alternate Sources of energy:	
Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources.	**3 Lectures**
Solar energy:	
Solar energy, It's importance, storage of solar energy (Thermal storage and Electrical storage, Mechanical storage), solar pond (Basic idea), Principle of operation of non-convective solar pond, applications of solar pond, solar water heating, flat plate collector, solar cooker (basic idea, Design principle and Constructional details of box type solar cooker and its limitation), solar furnace, solar green-houses (basic idea, types and advantage), Solar Cell principle (No mathematical treatment), application of solar photovoltaic system, advantage and disadvantage of Photovoltaic solar energy conversion.	**6 Lectures**
Wind Energy harvesting:	
Fundamentals of Wind energy, Basic principle of wind energy conversion, power of wind, Forces on the blades and thrust on turbine, Basic components of a Wind energy Conversion system, Advantage and disadvantage of Wind energy Conversion system	**4 Lectures**
Ocean Energy:	
Ocean thermal energy conversion(OTEC)(basic idea), Open cycle OTEC system, Closed cycle OTEC system, Basic idea of Heat exchanger, Basic principle of tidal power, Basic idea about components of tidal power plant, Estimate of power in simple Single basin tidal system.	**3 Lectures**
Geothermal Energy:	
Geothermal energy (Basic idea), Geothermal sources, Hydrothermal resources (basic idea of vapour dominated system and liquid dominated system), applications of geothermal energy, advantages and disadvantages of geothermal energy.	**3 Lectures**
Hydro Energy:	
Hydropower resources, Types of hydroelectric project (Run-of-river schemes, Storage schemes, Pumped-Storage schemes, Low head power plant, Medium head power plant, High head power station), environmental impact of hydro power sources	**4 Lectures**

Piezoelectric Energy harvesting:	
Introduction, Physics and characteristics of piezoelectric effect (No mathematical treatment), materials used for piezoelectricity, recent application of piezoelectric generators.	**5 Lectures**
Electromagnetic Energy Harvesting:	
Linear generators (principle of linear generator, applications)	**2 Lectures**

Reference Books:

- Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
- Solar energy - M P Agarwal - S Chand and Co. Ltd
- Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
- Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, inassociation with The Open University.
- Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009
- J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
- https://www.yumpu.com/en/document/read/11678381/module-5-nptel
- http://en.wikipedia.org/wiki/Renewable_energy

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