# Jamshedpur Women’s College,

Department of Physics

# U G PHYSICS (HONS.) SYLLABUS

SEMESTER I

**CC-I: Mathematical Physics-I**

**Credit : 06 (Theory-04, Practical-02)**

**Theory : 60 Hours**

**Practical : 60 Hours**

**PHYSICS-C I: MATHEMATICAL PHYSICS-I(Credits: Theory-04, Practicals-02) Theory: 60 Lectures** The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.

**Unit 1**

**Calculus**: Taylor and binomial series (statements only). (2 Lectures)

**First Order Differential Equations**: First Order Differential Equations :separation of variables homogeneous and non-homogeneous, exact and inexact differential equations and Integrating factors. (5 lectures)

**Second Order Differential equations**: Homogeneous Equations with constant coefficients.ParticularIntegral with operator methodWronskian and general solution.**(14 Lectures)**

**Unit 2**

**Vector Analysis:**

**Vector Algebra**:Scalar and Vector product, triple scalar product, interpretation in terms of area and volume, triple cross product ,product of four vectors, scalar and vector fields**(5 lectures)**

**Vector Differentiation**: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation.Divergence and curl of a vector field.Del and Laplacian operators. Vector identities**.(10 lectures)**

**Vector Integration**: Ordinary Integrals of Vectors. Double and triple integrals, change of order of integration, Jacobian.Notion of infinitesimal line, surface and volume elements, Line, surface and volume integrals of Vector fields.Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their verification (no rigorous proofs). **(16 Lectures)**

**Unit 3**

**Orthogonal Curvilinear Coordinates:**Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. **(6 Lectures)**

**Unit 4**

**Dirac Delta function and its properties**: Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function.Properties of Dirac delta function.**(2 Lectures)**

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn.,Elsevier
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning

3. Differential Equations, George F. Simmons, 2007, McGraw Hill.

4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.

1. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
2. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
3. Mathematical Physics, Goswami, 1st edition, Cengage Learning
4. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
5. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
6. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press.
7. Mathematical Physics, H.K. Dass and R. Verma, S. Chand & Company.

**PHYSICS LAB- C I LAB: 60 Lectures**

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics. Highlights the use of computational methods to solve physical problems

• The course will consist of lectures (both theory and practical) in the Lab

• Evaluation done not on the programming but on the basis of formulating the problem

• Aim at teaching students to construct the computational problem to be solved

• Students can use any one operating system Linux or Microsoft Windows•

* At least 12 programs must be attempted from the following covering the entire syllabus.
* The list of programs here is only suggestive. Students should be encouraged to do more practice.

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| --- | --- |
| Topics | Descriptions with Applications |
| Introduction and Overview | Computer architecture and organization, memory and  Input/output devices, |
| Basics of scientific computing | Binary and decimal arithmetic, Floating point numbers, single and double precision arithmetic, underflowand  overflow - emphasize the importance of making equations in terms of dimensionless variables, Iterative methods |
| Algorithms and Flow charts | Purpose, symbols and description, |
| Introduction to C++ | Introduction to Programming: Algorithms: Sequence, Selection and Repetition, Structured programming, basic idea of Compilers. Data Types, Enumerated Data, Conversion & casting, constants and variables, Mathematical, Relational, Logical and Bit wise Operators. Precedence of Operators, Expressions and Statements, Scope and Visibility of Data, block, Local and Global variables, Auto, static and External variables.  Programs:   * To calculate area of arectangle * To check size of variables in bytes (Use of sizeof( ) Operator) * converting plane polar to Cartesian coordinates and viceversa |

|  |  |
| --- | --- |
| C++ Control Statements | if-statement, if-else statement, Nested if Structure, Else-if statement, Ternary operator, Goto statement, switch statement, Unconditional and Conditional looping, While loop, Do-while loop, For loop, nested loops, break and continue statements  Programs:   * To find roots of a quadraticequation * To find largest of threenumbers * To check whether a number is prime ornot * To list Prime numbers up to1000 |
| Random Number generator | Generating pseudo random numbers To find value of pi using Monte Carlo simulations. To integrate using Monte Carlo Method |
| Arrays and Functions | Sum and average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order using Bubble sort and Sequential sort, Binary search, 2-dimensional arrays, matrix operations (sum, product, transposeetc) |
| Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson  and Secant methods | Solution of linear and quadratic equation, solving α = tanα; I=I0 [(sin α)/ α]2 in optics, square root of a number. |
| Data Analysis and Least Square Fitting (Linear case) | Uncertainty, error and precision, mean, standard deviation and error in the mean. Combining uncertainties, Least squares method for fitting data: linear (y = ax+b), power law(y = axb) and exponential (y = aebx). To find parameters a, b and errors in them using method of least squares. Ohms law- calculate R, Hooke’s law - Calculate springconstant. |
| Numerical differentiation (Forward and Backward and central difference formulae–  Using basic definition) | Given Position with equidistant time data calculate velocity and acceleration |

#### References for Laboratory Work:

1. Schaum's Outline of Programming with C++’, J. Hubbard, 2000, McGraw-Hill Education.
2. C++ How to Program’, Paul J. Deitel and Harvey Deitel, Pearson(2016).
3. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt.Ltd.
4. ComputationalPhysics,DarrenWalker,1stEdn.,ScientificInternationalPvt.Ltd(2015).
5. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley IndiaEdition.

# CC-II: Mechanics Credit : 06

# (Theory-04, Practical-02)

**Theory : 60 Hours Practical : 60 Hours**

**PHYSICS-C II: MECHANICS (Credits: Theory-04, Practicals-02) Theory: 60 Lectures**

**Unit 1**

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton’sLaws of Motion. Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. (6 Lectures)

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by nonconservative forces. Law of conservation of Energy. (4 Lectures)

**Unit 2**

**Collisions:** Elastic and inelastic collisions between particles. Centre of Mass and Laboratory

frames. (3 Lectures)

**Rotational Dynamics**: Angular momentum of a particle and system of particles.Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation. (12 Lectures) Review only

**Elasticity:** Relation between Elastic constants. Twisting torque on a Cylinder or Wire. (3 Lectures)

**Fluid Motion:** Kinematics of Moving Fluids: Poiseuille’s Equation for Flow of a Liquidthrough a Capillary Tube. (2 Lectures)

**Gravitation and Central Force Motion:** Law of gravitation. Gravitational potentialenergy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. (3 Lectures)

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler’s Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). (6 Lectures)

**Unit 3**

**Oscillations:** SHM: Simple Harmonic Oscillations. Differential equation of SHM and itssolution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. (7 Lectures)

**Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. (4 Lectures)

**Special Theory of Relativity:** Michelson-Morley Experiment and its outcome.Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Massenergy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum. (10 Lectures)

Reference Books: An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.

• Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.

• Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.

• Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning

• Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education

• Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.

• University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

• Additional Books for Reference

Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000

• University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley

• Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning

• Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill

**Practical : 60 Hours**

Demonstration cum laboratory sessions on the construction and use of Vernier callipers, screw gauge and travelling microscope, and necessary precautions during their use.

Sessions and exercises on the least count errors, their propagation and recording in final result up to correct significant digits, linearization of data and the use of slope and intercept to determine unknown quantities.

Session on the writing of scientific laboratory reports, which may include theoretical and practical significance of the experiment performed, apparatus description, relevant theory, necessary precautions to be taken during the experiment, proper recording of observations, data analysis, estimation of the error and explanation of its sources, correct recording of the result of the experiment, and proper referencing of the material taken from other sources (books, websites, research papers, etc.)

At least 06 experiments from the following

1. Measurementsoflength(ordiameter)usingVernierCalliper,screwgaugeandtravelling microscope.
2. To study the random error inobservations.
3. To determine the height of a building using aSextant.
4. To study the motion of the spring and calculate (a) Spring constant and, (b)g.
5. To determine the Moment of Inertia of aFlywheel.
6. To determine g and velocity for a freely falling body using Digital TimingTechnique.
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by Optical LeverMethod.
9. To determine the Modulus of Rigidity of a Wire by Maxwell'sneedle.
10. To determine the elastic Constants of a wire by Searle'smethod.
11. To determine the value of g using BarPendulum.
12. To determine the value of g using Kater'sPendulum.

#### References for Theory:

**Essential Readings:**

1. An Introduction to Mechanics (2/e), Daniel Kleppner & Robert Kolenkow, 2014, Cambridge UniversityPress.
2. Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw HillEducation.
3. Theory and Problems of Theoretical Mechanics, Murray R. Spiegel, 1977,McGraw HillEducation.
4. Intermediate Dynamics, Patrick Hamill, 2010, Jones and BartlettPublishers.
5. Analytical Mechanics, G. R. Fowles and G. L. Cassiday, 2005, CengageLearning.

#### Additional Readings:

1. Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
2. University Physics, Ronald Lane Reese, 2003, ThomsonBrooks/Cole.
3. University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, PearsonEducation.
4. Fundamentals of Physics, Resnick, Halliday & Walker 10/e, 2013,Wiley.
5. Engineering Mechanics, Basudeb Bhattacharya, 2/e, 2015, Oxford UniversityPress.
6. Physics for Scientists and Engineers, R. A. Serway, J. W. Jewett, Jr, 9/e, 2014, Cengage Learning.
7. Mechanics, D. S. Mathur, P. S. Hemne, 2012, S.Chand.

#### References for Laboratory Work:

1. Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia PublishingHouse.
2. EngineeringPracticalPhysics,S.Panigrahi&B.Mallick,2015,CengageLearningIndia Pvt.Ltd.
3. Practical Physics, G. L. Squires, 2015, 4/e, Cambridge UniversityPress.
4. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11/e, 2011, KitabMahal.

## GE: Mechanics Credit : 06 (Theory-04, Practical-02)

**Theory : 60 Hours Practical : 60 Hours**

##### Unit 1

**Vectors:** Vector algebra. Derivatives of a vector with respect to a parameter. Scalar and vector products of two, three and four vectors. Gradient, divergence and curl of vectors fields. Polar and Axial vectors.

##### (5 Lectures)

**Ordinary Differential Equations:**1st order homogeneous differential equations, exact and non-exact differential equations, 2nd order homogeneous and non-homogenous differential equations with constant coefficients (Operator Method Only).

##### (8 Lectures)

**Unit 2**

**Laws of Motion:** Review of Newton's Laws of motion. Dynamics of a system of particles. Concept of Centre of Mass, determination of center of mass for discrete and continuous systems having cylindrical and spherical symmetry (1-D, 2-D, 3-D objects).

**(6 Lectures) Work and Energy:** Motion of rocket. Work-Energy theorem for conservative forces. Force as a gradient of Potential Energy. Conservation of momentum and energy. Elastic and in- elastic Collisions.

##### (5 Lectures)

**Unit 3**

**Rotational Dynamics**: Angular velocity, Angular momentum, Torque, Conservation of angular momentum, Moment of Inertia. Theorem of parallel and perpendicular axes. Calculation of Moment of Inertia of discrete and continuous objects (1-D, 2-D and 3-D). Kinetic energy of rotation. Motion involving both translation and rotation.

##### (10 Lectures)

**Unit 4**

**Gravitation:** Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statements only). Satellite in circular orbit and applications. Geosynchronous orbits.

##### (5 Lectures)

**Unit 5**

**Oscillations**: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Compound pendulum. Differential equations of damped oscillations and its solution.

##### (7 Lectures)

**Unit 6**

**Special Theory of Relativity:** Frames of reference. Gallilean Transformations. Inertial and Non-inertial frames. Outcomes of Michelson Morley's Experiment. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic transformation of velocity. Relativistic variation of mass. Mass-energy equivalence. Transformation of Energy and Momentum.

##### (14 Lectures)

Note: Students are not familiar with vector calculus. Hence all examples involve differentiation either in one dimension or with respect to the radial coordinate.

### Practical: 60 Hours

##### PRACTICALS- GE LAB: Mechanics Lab

Demonstration cum laboratory sessions on the construction and use of Vernier callipers, screw gauge and travelling microscope, and necessary precautions during their use.

Sessions and exercises on the least count errors, their propagation and recording in final result up to correct significant digits, linearization of data and the use of slope and intercept to determine unknown quantities.

Session on the writing of scientific laboratory reports, which may include theoretical and practical significance of the experiment performed, apparatus description, relevant theory, necessary precautions to be taken during the experiment, proper recording of observations, data analysis, estimation of the error and explanation of its sources, correct recording of the result of the experiment, and proper referencing of the material taken from other sources (books, websites, research papers, etc.)

At least 05 experiments from the following:

1. Measurements of length (or diameter) using Vernier calliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the motion of the spring and calculate (a) Spring constant and, (b) g.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine g and velocity for a freely falling body using Digital Timing Technique.
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
10. To determine the elastic constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.

##### References for Theory:

 University Physics.FW Sears, MW Zemansky & HD Young13/e, 1986.

 Addison-Wesley Mechanics Berkeley Physics course, vol.1

 Charles Kittel,et.al. 2007, Tata McGraw-Hill Physics.

 Resnick, Halliday & Walker 9/e, 2010, Wiley.

 Engineering Mechanics, Basudeb Bhattacharya, 2nd ed., 2015, Oxford University Press.

 University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

##### References for Practical:

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Engineering Practical Physics, S. Panigrahi and B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. An Advanced Course in Practical Physics, D. Chattopadhyay & P. C. Rakshit, 2013, New Book Agency (P) Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press
6. B.Sc. Practical Physics, H. Singh & P. S. Hemne, 2011, S Chand and Company Ltd
7. B.Sc. Practical Physics, C. L. Arora, 2011, S Chand and Company Ltd.

# SEMESTER II

# CC-III: Electricity and Magnetism Credit: 06 (Theory-04, Practical-02)

**Theory: 60 Hours**

**Practical: 60 Hours**

PHYSICS-C III: ELECTRICITY AND MAGNETISM (Credits: Theory-04, Practicals-02) Theory: 60 Lectures

**UNIT 1**

Electric Field and Electric Potential Electric field: Electric field lines. Electric flux. Gauss’ Law with applications to chargedistributions 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 Torque on 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. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. (10 Lectures) Review

Dielectric Properties of Matter: Electric Field in matter. Polarization, PolarizationCharges. 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)

**UNIT 2**

Magnetic Field: Magnetic force between current elements and definition of MagneticFieldB. 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) Solenoid and (2) 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. Ferromagnetism. B-H curve and hysteresis. (4 Lectures)

Electromagnetic Induction: Faraday’s Law. Lenz’s Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell’s Equations. Charge Conservation and Displacement current. (6 Lectures)

**UNIT 3**

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: Thevenin 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

Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education

• 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

• Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

• Electricity and Magnetism, J.H.Fewkes•& J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

**Practical : 60 Hours**

Dedicated demonstration cum laboratory sessions on the construction, functioning and uses of different electrical bridge circuits, and electrical devices like the ballistic galvanometer.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.

Sessions on least square fitting and computer programme to find slope and intercept of straight-line graphs of experimental data. Application to the specific experiments done in the lab.

At least 6 experiments from the following:

1. To study the characteristics of a series RCCircuit.
2. To determine an unknown Low Resistance usingPotentiometer.
3. To determine an unknown Low Resistance using Carey Foster’sBridge.
4. To compare capacitances using De’Sauty’sbridge.
5. Measurement of field strength B and its variation in a solenoid (determinedB/dx)
6. To verify the Thevenin and Nortontheorems.
7. To verify the Superposition, and Maximum power transfertheorems.
8. To determine self inductance of a coil by Anderson’sbridge.
9. 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) Bandwidth.
10. TostudytheresponsecurveofaparallelLCRcircuit anddetermine its(a)Anti-resonant frequency and (b) Quality factorQ.
11. Measurement of charge sensitivity, current sensitivity and CDR of Ballistic Galvanometer
12. Determine a high resistance by leakage method using BallisticGalvanometer.
13. To determine self-inductance of a coil by Rayleigh’smethod.
14. To determine the mutual inductance of two coils by Absolutemethod.

#### References for Theory:

**Essential Readings:**

1. FundamentalsofElectricityandMagnetism,ArthurF.Kip,2ndEdn.1981,McGraw-Hill.
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-HillEducation
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, BenjaminCummings.
4. Electricity and Magnetism, J.H.Fewkes& J.Yarwood. Vol.I, 1991, Oxford Univ.Press.
5. Network, Lines and Fields, John D. Ryder, 2nd Edn., 2015,Pearson.

#### Additional Readings:

1. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
2. Electricity,Magnetism&ElectromagneticTheory,S.MahajanandChoudhury,2012,Tata McGraw
3. Electricity and Magnetism, J.H.Fewkes& J.Yarwood. Vol.I, 1991, Oxford Univ.Press.
4. ProblemsandSolutionsinElectromagnetics(2015),AjoyGhatak,KThyagarajan&Ravi Varshney.
5. Schaum’s Outline of Electric Circuits, J. Edminister & M. Nahvi, 3rd Edn., 1995, McGraw Hill.

#### References for Laboratory Work:

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia PublishingHouse
2. ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11thEd.,2011,KitabMahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann EducationalPublishers
4. Engineering Practical Physics, S.Panigrahi and B.Mallick,2015, CengageLearning.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge UniversityPress

## CC-IV: Waves and Optics Credit : 06 (Theory-04, Practical-02) Theory : 60 Hours

##### **Unit 1**

**Superposition of Collinear Harmonic oscillations**: Simple harmonic motion (SHM). Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear HarmonicOscillationswith(1)equalphasedifferencesand(2)equalfrequencydifferences. (6 Lectures)

**Superposition of two perpendicular Harmonic Oscillations**: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequencies and their uses.(2 Lectures)

**Wave Motion:** Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Pressure of a Longitudinal Wave. Energy Transport. Intensity ofWave.(4Lectures)

**Superposition of Two Harmonic Waves**: Standing (Stationary) Waves in a String: Fixed andFreeEnds.AnalyticalTreatment.PhaseandGroupVelocities.ChangeswithrespecttoPosition and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N HarmonicWaves.(8 Lectures)

**Unit 2**

**Wave Optics:** Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.(4 Lectures)

**Interference:** Division of amplitude and wavefront. Young’s double slit experiment. Lloyd’s Mirror and Fresnel’s Biprism. Phase change on reflection: Stokes’ treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton’s Rings: Measurement of wavelength and refractiveindex.(10Lectures)

**Interferometer**: Michelson Interferometer-(1) Idea of form of fringes(No theory required),

1. Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perotinterferometer . (6 Lectures)

**Unit 3 Diffraction:**

**Fraunhofer diffraction**: Single slit. Rectangular and Circular aperture, Resolving Power of

a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

##### (10 Lectures)

Fresnel Diffraction: Fresnel’s Assumptions. Fresnel’s Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel’s Integral, Cornu`s spiral and its applications. Straight edge, a slit and a wire.

##### (10 Lectures)

**Practical: 60 Hours**

Dedicated demonstration cum laboratory session on the construction, and use of spectrometer and lasers, and necessary precautions during their use.

Sessions on the review of experimental data analysis, sources of error and their estimation in detail, writing of scientific laboratory reports including proper reporting of errors.

Application to the specific experiments done in the lab. At least 06 experiments from the following:

1. TodeterminethefrequencyofanelectrictuningforkbyMelde’sexperimentandverify

λ2–T law.

1. To investigate the motion of coupledoscillators.

# Generic Elective-(GE)

## GE: Electricity and Magnetism Credit : 06 (Theory-04, Practical-02) Theory : 60 Hours

**Practical : 60 Hours**

##### Unit 1

**Vector Analysis:** Vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

##### (20 Lectures)

**Unit 2**

**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. 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. 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.

##### (22 Lectures)

**Unit 3 Magnetism:**

**Magnetostatics:** Biot-Savart's law and its applications- straight conductor, circular coil, 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 ferro-magnetic materials.

##### (10 Lectures)

**Unit 4**

**Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

##### (6 Lectures)

Introduction to Maxwell`s equations.

### Practical : 60 Hours

##### PRACTICALS-GE LAB:

##### Electricity and Magnetism Lab**(2 Lectures)**

Dedicated demonstration cum laboratory sessions on the construction, functioning and uses of different electrical bridge circuits, and electrical devices like the ballistic galvanometer.

Sessions on the review of scientific laboratory report writing, and on experimental data analysis, least square fitting, and computer programme to find slope and intercept of straight line graphs of experimental data.

At least 05 experiments from the following:

1. Ballistic Galvanometer:
   1. Measurement of charge and current sensitivity
   2. Measurement of CDR
   3. Determine a high resistance by Leakage Method
   4. To determine Self Inductance of a Coil by Rayleigh’s Method.
2. To compare capacitances using De’Sauty’s bridge.
3. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
4. To study the Characteristics of a Series RC Circuit.
5. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
6. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
7. To determine a Low Resistance by Carey Foster’s Bridge.
8. To verify the Thevenin and Norton theorems
9. To verify the Superposition, and Maximum Power Transfer Theorems

##### References for Theory :

##### 1Vector analysis – Schaum’s Outline, M.R. Spiegel, S. Lipschutz, D. Spellman, 2nd Edn., 2009, McGraw- Hill Education.

2.Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.

 Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ.Press

 Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.

 University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

 D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

##### References for Practical:

 Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.

 Engineering Practical Physics, S. Panigrahi and B.Mallick, 2015, Cengage Learning India Pvt. Ltd.

 A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.2011, Kitab Mahal.

 An Advanced Course in Practical Physics, D. Chattopadhyay & P. C. Rakshit, 2013, New Book Agency (P) Ltd.

 Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press

 B.Sc. Practical Physics, H. Singh & P. S. Hemne, 2011, S Chand and Company Ltd

 B.Sc. Practical Physics, C. L. Arora, 2011, S Chand and Company Ltd.To study LissajousFigures.

1. Familiarization with: Schuster`s focusing; determination of angle ofprism.
2. To determine refractive index of the Material of a prism using sodiumsource.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercurysource.
4. To determine the wavelength of sodium source using Michelson’sinterferometer.
5. To determine wavelength of sodium light using FresnelBiprism.
6. To determine wavelength of sodium light using Newton’sRings.
7. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shapedFilm.
8. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffractiongrating.
9. To determine dispersive power and resolving power of a plane diffractiongrating.

##### References for Theory:

1. Vibrations and Waves, A.P. French, 1stEdn., 2003, CRCpress.
2. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007,Tata McGraw-Hill.
3. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981,McGraw-Hill
4. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, PergamonPress.
5. Optics, (2017), 6th Edition, Ajoy Ghatak, McGraw-Hill Education, NewDelhi
6. ThePhysicsofVibrationsandWaves,H.J.Pain,2013,JohnWileyandSons.
7. ThePhysicsofWavesandOscillations,N.K.Bajaj,1998,TataMcGrawHill.
8. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications
9. Optics, Eugene Hecht, 4thEdn., 2014, PearsonEducation.

##### References for Practical:

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia PublishingHouse
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011,Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann EducationalPublishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal,1985, VaniPub.
5. An Advanced Course in Practical Physics, D. Chattopadhyay & P. C. Rakshit, 2013, New Book Agency (P)Ltd.
6. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge UniversityPress
7. B.Sc.PracticalPhysics,H.Singh&P.S.Hemne,2011,SChandandCompanyLtd
8. B.Sc. Practical Physics, C. L. Arora, 2011, S Chand and CompanyLtd.