

CENTRAL UNIVERSITY OF HARYANA

(Established under the Central Universities Act, 2009)

(NAAC Accredited 'A' Grade)



Curriculum and Syllabi Of Integrated B.Sc.-M.Sc. (Physics)

(w.e.f. October 2021)

DEPARTMENT OF PHYSICS & ASTROPHYSICS SCHOOL OF BASIC SCIENCES

Approved by :	BOS	School Board	Academic Council
Approval Status :	Approved	Approved	Approved
Approval Date :	08-09-2021	20-09-2021	12-10-2021

STRUCTURE OF Integrated BSc-MSc Programme

Course Structure (Physics-Major)

Details of courses under B.Sc. (Honors)

Course	*Credits	
	Theory+ Practical	Theory + Tutorial
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I. Core Course		
(14 Papers)	14X4= 56	14X5=70
Core Course Practical / Tutorial*		
(14 Papers)	14X2=28	14X1=14
II. Elective Course		
(8 Papers)		
A.1. Discipline Specific Elective	4X4=16	4X5=20
(4 Papers)		
A.2. Discipline Specific Elective		
Practical/Tutorial*	4 X 2=8	4X1=4
(4 Papers)		
B.1. Generic Elective/		
Interdisciplinary	4X4=16	4X5=20
(4 Papers)		
B.2. Generic Elective		
Practical/ Tutorial*	4 X 2=8	4X1=4
(4 Papers)		
<ul style="list-style-type: none"> • Optional Dissertation or project work in place of one Discipline Specific Elective paper (6 credits) in 6th Semester 		
III. Ability Enhancement Courses		
1. Ability Enhancement Compulsory		
(2 Papers of 4 credit each)	2 X 4=8	2 X 4=8
Environmental Science		
English/MIL Communication		
Sanskrit/Hindi		
2. Ability Enhancement Elective (Skill Based)		
(Minimum 2)	2 X 4=8	2 X 4=8
(2 Papers of 2 credit each)		
Total credit	148	148

Institute should evolve a system/policy about ECA/ General

Interest/Hobby/Sports/NCC/NSS/related courses on its own.

*** wherever there is a practical there will be no tutorial and vice-versa**

**** University may add more choices for Ability Enhancement compulsory and Ability Enhancement Elective (Skill Based) courses.**

SEMESTER-WISE COURSES AND CREDIT DISTRIBUTION

Scheme and Syllabus of Integrated BSc-MSc in Physics
(CHOICE BASED CREDIT SYSTEM)

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Semester I

Total credits: 22

S. No.	Course Title	Course Code	L	T	P	Credits
1	Mathematical Physics-I		4	0	0	4
2	Mechanics		4	0	0	4
3	Ability Enhancement Compulsory course-1		4	0	0	4
4	Generic Elective-1		4	0	0	4
5	Mathematical Physics-1 Lab		2	0	0	2
6	Mechanics Lab		2	0	0	2
7	Generic Elective-1 Practical		0	0	4	2

Semester II

Total credits: 22

S. No.	Course Title	Course Code	L	T	P	Credits
1	Electricity and Magnetism		4	0	0	4
2	Waves and Optics		4	0	0	4
3	Ability Enhancement Compulsory course-2		4	0	0	4
4	Generic Elective-2		5	0	0	5
5	Electricity and Magnetism lab		0	0	4	2
6	Waves and Optics Lab		0	0	4	2
7	Generic Elective-2 Practical/Tutorial		0	0	1	1

Exit Options: Exit plan will be as per relevant ordinance.

**Generic Elective Papers (GE) (Minor Physics) (any four) for other Departments/Disciplines:
(Credit: 06 Each)**

- 1. Mechanics**
- 2. Electricity and Magnetism**
- 3. Waves and Optics**
- 4. Mathematical Physics**

CORE COURSE (HONOURS IN PHYSICS)

SEMESTR - I

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.

Calculus:

Recapitulation: Limits, continuity, average and instantaneous quantities, differentiation. Plotting functions. Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only).

(2 Lectures)

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral.

(13 Lectures)

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.

(6 Lectures)

Vector Calculus:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. 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.

(8 Lectures)

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, 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 applications (no rigorous proofs).

(14 Lectures)

Orthogonal Curvilinear Coordinates:

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

Introduction to probability:

Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance.

Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing. **(4 Lectures)**

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:

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
 - An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
 - Differential Equations, George F. Simmons, 2007, McGraw Hill.
 - Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
 - Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
 - Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
 - Mathematical Physics, Goswami, 1st edition, Cengage Learning
 - Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
 - Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
 - Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press
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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*

Topics	Description 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, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow-emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (<i>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. Break and Continue Statements. Nested Loops</i>), Arrays (<i>1D & 2D</i>) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs:	Sum & 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, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of pi (π)
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving $\left(\frac{\sin \alpha}{\alpha} \right)^2$ in optics $\alpha = \tan \alpha ; I = I_0 \left[\frac{\sin \alpha}{\alpha} \right]$
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. $\sin \theta$, $\cos \theta$, $\tan \theta$, etc.
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method	Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop

<p>Solution of Ordinary Differential Equations (ODE)</p> <p>First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods</p>	<p>First order differential equation</p> <ul style="list-style-type: none"> Radioactive decay Current in RC, LC circuits with DC source Newton's law of cooling Classical equations of motion <p>Attempt following problems using RK 4 order method:</p> <ul style="list-style-type: none"> Solve the coupled differential equations $\frac{dx}{dt} = y + x - \frac{x^3}{3}; \frac{dy}{dx} = -x$ for four initial conditions $x(0) = 0, y(0) = -1, -2, -3, -4.$ Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$ <p>The differential equation describing the motion of a pendulum is $\frac{d^2P}{dt^2} = -\sin(P)$. The pendulum is released from rest at an angular displacement α, i. e. $P(0) = \alpha$ and $P'(0) = 0$. Solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot P as a function of time in the range $0 \leq t \leq 8\pi$. Also plot the analytic solution valid for small P ($\sin(P) = P$)</p>
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Referred Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
 - Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.
 - Numerical Recipes in C: The Art of Scientific Computing, W.H. Press et al, 3rd Edn. , 2007, Cambridge University Press.
 - A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
 - Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn. , 2007 , Wiley India Edition.
 - Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
 - An Introduction to computational Physics, T.Pang, 2nd Edn. , 2006, Cambridge Univ. Press
 - Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.
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PHYSICS-C II: MECHANICS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws 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 non-conservative forces. Law of conservation of Energy. **(4 Lectures)**

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)**

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 Liquid through a Capillary Tube. **(2 Lectures)**

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. 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)**

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. 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. Mass-energy 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.
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PHYSICS LAB-C II LAB

60 Lectures

1. Measurements of length (or diameter) using vernier caliper, 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 Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
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.

Reference Books

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
 - Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
 - A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
 - Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
 - Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
 - Advanced Practical Physics, Vol. I, S. P. Singh, 2020, Pragati Prakashan
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SEMESTER - II

PHYSICS-C III: ELECTRICITY AND MAGNETISM

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

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 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)**

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) 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)**

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.
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PHYSICS LAB-C III LAB

60 Lectures

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 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.

Reference Books

- 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
 - Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning.
 - A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Pub.
 - Advanced Practical Physics Vol. II, S. P. Singh, 2020, Pragati Prakashan.
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PHYSICS-C IV: WAVES AND OPTICS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Superposition of Collinear Harmonic oscillations: Linearity and Superposition

Principle. Superposition of two collinear oscillations having (1) equal frequencies and

(2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **(5 Lectures)**

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical

Methods. Lissajous Figures with equal and unequal frequency 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. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. **(4 Lectures)**

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. **(6 Lectures)**

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal

Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves. **(7 Lectures)**

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. **(3 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 refractive index. **(9 Lectures)**

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. **(4 Lectures)**

Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) **(2 Lectures)**

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. **(8 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, Fresnel diffraction pattern of a straight edge, a slit and a wire. **(7 Lectures)**

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms. **(3 Lectures)**

Reference Books

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
- Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

60 Lectures

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda^2 - T$ law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster's focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

- 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.
 - Advanced Practical Physics Vol. II, S. P. Singh, 2020, Pragati Prakashan
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Generic Elective Papers (GE) (Minor-Physics) (any four) for other Departments/Disciplines: (Credit: 06 each)

GE: MECHANICS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. **(4 Lectures)**

Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients. **(6 Lectures)**

Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. **(10 Lectures)**

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. **(6 Lectures)**

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. **(5 Lectures)**

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 (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Basic idea of global positioning system (GPS). Weightlessness. Physiological effects on astronauts. **(8 Lectures)**

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. **(6 Lectures)**

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion - Torsional

pendulum-Determination of Rigidity modulus and moment of inertia - q , η and σ by Searles method. (8 Lectures)

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities. (7 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

Reference Books:

- University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley
 - Mechanics Berkeley Physics, v.1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
 - Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
 - Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
 - University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
-

PHYSICS LAB: GE LAB: MECHANICS

60 Lectures

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To study the Motion of a Spring and calculate (a) Spring Constant, (b) g .

Reference Books:

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
 - Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
 - Engineering Practical Physics, S.Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
 - A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
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GE: ELECTRICITY AND MAGNETISM

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Vector Analysis: Review of 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).

(12 Lectures)

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)

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)

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)

Maxwell's equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

(10 Lectures)

Reference Books:

- 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.
-

GE LAB: ELECTRICITY AND MAGNETISM

60 Lectures

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. 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.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorems
10. To verify the Superposition, and Maximum Power Transfer Theorems

Reference Books

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
 - Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
 - A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.2011, Kitab Mahal
 - Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
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GE: WAVES AND OPTICS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

Superposition of Two Collinear Harmonic oscillations: Linearity & Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). **(4 Lectures)**

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their uses. **(2 Lectures)**

Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity. **(7 Lectures)**

Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaeger's method. Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of liquid with temperature- lubrication. **(6 Lectures)**

Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria. **(6 Lectures)**

Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle. **(3 Lectures)**

Interference: Interference: Division of amplitude and division of 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 refractive index.

(10 Lectures)

Michelson's Interferometer: Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index, and Visibility of fringes.

(3 Lectures)

Diffraction: Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

(14 Lectures)

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

(5 Lectures)

Reference Books:

- Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications
- University Physics. F.W. Sears, M.W. Zemansky and H.D. Young. 13/e, 1986. Addison-Wesley

GE LAB: WAVES AND OPTICS

60 Lectures

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda^2 - T$ Law.
3. To study Lissajous Figures
4. Familiarization with Schuster's focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a Prism using Mercury Light
8. To determine the value of Cauchy Constants.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium and (2) Spectral lines of the Mercury

light using plane diffraction Grating

14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

Reference Books:

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
 - Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
 - A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
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1. To design a CE amplifier of given gain (mid-gain) using voltage divider bias.
2. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
3. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response.
4. To study Differential Amplifier of given I/O specification using Op-amp.
5. To investigate a differentiator made using op-amp.
6. To design a Wien Bridge Oscillator using an op-amp.

Reference Books:

- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
 - Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
 - OP-Amps & Linear Integrated Circuit, R.A. Gayakwad, 4th Edn, 2000, Prentice Hall.
 - Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
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GE: MATHEMATICAL PHYSICS

(Credits: Theory-04, Practicals-02)

Theory: 60 Lectures

The emphasis of the course is on applications in solving problems of interest to physicists. Students to be examined on the basis of problems, seen and unseen.

Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers. **(6 Lectures)**

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. **(10 Lectures)**

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite & Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations. **(16 Lectures)**

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). **(4 Lectures)**

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. **(10 Lectures)**

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. **(14 Lectures)**

Reference Books:

- Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.

- Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
 - Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
 - An Introduction to Ordinary Differential Equations, E.A Coddington, 1961, PHI Learning
 - Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
 - Partial Differential Equations for Scientists and Engineers, S.J. Farlow, 1993, Dover Publications.
 - Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books.
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GE LAB: MATHEMATICAL PHYSICS

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.

- *The course will consist of lectures (both theory and practical) in the Lab*
- *Evaluation done on the basis of formulating the problem*
- *Aim at teaching students to construct the computational problem to be solved*

Topics	Description 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, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow-emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (<i>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. Break and Continue Statements. Nested Loops</i>), Arrays (<i>1D & 2D</i>) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs: using C/C++ language	Sum & 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, Binary search

Random number generation	Area of circle, area of square, volume of sphere, value of π
Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods	Solution of linear and quadratic equation, solving $\alpha = \tan \alpha$; $I = I_0 \left[\frac{\sin \alpha}{\alpha} \right]^2$ in optics
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. $\sin \theta$, $\cos \theta$, $\tan \theta$, etc.
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method	Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop
<p>Solution of Ordinary Differential Equations (ODE)</p> <p>First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods</p>	<p>First order differential equation</p> <ul style="list-style-type: none"> Radioactive decay Current in RC, LC circuits with DC source Newton's law of cooling Classical equations of motion <p>Attempt following problems using RK 4 order method:</p> <ul style="list-style-type: none"> Solve the coupled differential equations $\frac{dx}{dt} = y + x - \frac{x^3}{3} ; \frac{dy}{dx} = -x$ for four initial conditions $x(0) = 0, y(0) = -1, -2, -3, -4$. Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$ <p>The differential equation describing the motion of a pendulum is $\frac{d^2P}{dt^2} = -\sin(P)$. The pendulum is released from rest at an angular displacement α, i. e. $P(0) = \alpha$ and $P'(0) = 0$. Solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot P as a function of time in the range $0 \leq t \leq 8\pi$. Also plot the analytic solution valid for small P ($\sin(P) = P$)</p>

Referred Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
- Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.
- Numerical Recipes in C++: The Art of Scientific Computing, W.H. Press et al., 3rd Edn., 2007, Cambridge University Press.
- A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
- Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India

Edition.

- Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
 - An Introduction to computational Physics, T. Pang, 2nd Edn., 2006, Cambridge Univ. Press
-

Ability Enhancement Courses:

AECC: English Communication

English Communication Credits: 4

1. Introduction: Theory of Communication, Types and modes of Communication

2. Language of Communication:

Verbal and Non-verbal

(Spoken and Written)

Personal, Social and Business

Barriers and Strategies

Intra-personal, Inter-personal and Group communication

3. Speaking Skills:

Monologue

Dialogue

Group Discussion

Effective Communication/ Mis- Communication

Interview

Public Speech

4. Reading and Understanding

Close Reading

Comprehension

Summary Paraphrasing

Analysis and Interpretation

Translation(from Indian language to English and vice-versa)

Literary/Knowledge Texts

5. Writing Skills

Documenting

Report Writing

Making notes

Letter writing

Recommended Readings:

1. *Fluency in English* - Part II, Oxford University Press, 2006.

2. *Business English*, Pearson, 2008.

3. *Language, Literature and Creativity*, Orient Blackswan, 2013.

4. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

ENVIRONMENTAL SCIENCES

Credits: 4

Unit-I: Introduction to Environmental Sciences

Definition, scope and importance of the environmental science, Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems.

Unit-II: Ecosystem

Introduction, kinds of ecosystem, structure and functions, abiotic and biotic component, Ecological energetics, Energy flow models, Food chain and Food web, Ecological Pyramids-types, Ecological succession, Introduction, types, structure and function of the following ecosystem :- a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems

Unit-III: Biodiversity and its conservation

Introduction – Definition, value and types: genetic, species and ecosystem diversity. Bio- geographical classification and Hot-spots of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation.

Unit-IV: Environmental issues and policies

Definition, cause, effects and control measures of Air, Water, Soil, Marine and Noise pollution. Solid Waste Management: Causes, effects and control measures of wastes. Seventeen Sustainable Developmental Goals, Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act, Public awareness.

REFERENCES

1. Bharucha E, (2002) The Biodiversity of India, Mapin Publishing
2. Cao G, Orru R (2014) Current Environmental Issues and Challenges. 2014th edition; Springer
3. Cunningham W P, Cunningham M A (2008) Principles of Environment Science. Enquiry and Applications. 5th Edition. Tata McGraw Hill, New Delhi
4. Dash M C, Dash S P (2009) Fundamentals of Ecology. 3rd McGraw Hill Education

5. Gibbs J, Malcolm L, Sterling J (2008) Problem-Solving in Conservation Biology and Wildlife Management. 2nd ed. Wiley-Blackwell
6. Ginley D, Cahen, D (2011) Fundamentals of Materials for Energy and Environmental Sustainability. Cambridge University Press
7. Gilbert M (2007) An Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi
8. Khan I (2019) Forest Governance and Sustainable Resource Management. SAGE Publications. India.
9. Odum E P, Barrett W, (2005) Fundamentals of Ecology. 5th ed. Cengage Learning.
10. Sharma P D (2017) Ecology and Environment. 13th ed. Rastogi Publications
11. Thangadurai D, Ching G, Jeyabalan S, Islam S (2019) Biodiversity and Conservation: Characterization and Utilization of Plants, Microbes and Natural Resources for Sustainable Development and Ecosystem Management. United States: Apple Academic Press
12. Trivedi R K (2010) Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, 3rd Edition. BS Publications

COURSE CODE: SHSS SKT 1201 GE 3104

प्राचीनभारतीयसंस्कृतिः, दर्शनं भाषाविज्ञानं च (1)

Prācīnabhāratiyaśamskr̥tiḥ, Darśanaṁ Bhāṣāvijñānaṁ Ca (1)

माध्यमः – संस्कृत/हिन्दी/आंग्लभाषा

Medium – Sanskrit/Hindi/English

L	T	P	Credits
3	1	0	4

उद्देश्यः/Objective:

1. संस्कृतेतर-विषयाणामध्येतृभ्यः संस्कृताध्ययनाय सौकर्योत्पादनम्; 2. भारतीयज्ञानसंपदाधारभूतानां वेदादि-शास्त्राणामुपनिषदां च रुचिरुत्पादनम्; 3. संस्कृतेनोपनिबद्धानां नीतिवाक्यानां गीतायां वर्णितस्य कर्मयोगस्य च तत्त्व-संधारणाय यत्नः; 4. सामान्य-भाषाविज्ञानस्य परिचयः।

पाठ्यक्रमाध्ययनस्य फलम् / Course Level Learning Outcome:

1. अध्येतारः वेदादि-शास्त्राणामुपनिषदां च तत्त्वान् ज्ञात्वा स्वाध्याय प्रयत्नशीलाः भवेयुः।
2. व्यावहारिकदृष्ट्या संस्कृतज्ञानेन अन्यविषयाणामध्येतारः तत्तद् स्वविषयानुगुणं संस्कृतभाषायामुप-लभ्यमानानां ग्रन्थानां प्रति यत्नशीलाः स्युः।
3. वेदोपनिषत्-गीता-नीतिशास्त्र-भाषाशास्त्रादीनां विषयाणां सम्यगध्ययनेनास्माकं पूर्वजानां वैदुष्येण परिचयः संजायेत।
4. भारतीय-चिन्तनपरम्परायाः समृद्धिं ज्ञातुमयं पाठ्यक्रमः प्रकृष्टमाध्यमः संजायेत।

पाठ्यक्रमः

मन्त्राणां सन्दर्भानां श्लोकानां च व्याख्या सारसंक्षेपश्च –

घटकम्-1: (क) यजुर्वेदः (34. 1-6)-शिवसंकल्पमन्त्राः; (ख) तैत्तिरीयोपनिषद् - शिक्षावल्ली (अनुशासनोपनिषद्)

घटकम्-2: भर्तृहरिः- नीतिशतकम् : 1-50 श्लोकाः

घटकम्-3: भगवद्गीता – तृतीयाध्यायः (कर्मयोगः)

घटकम्-4: सामान्यभाषाविज्ञानम्- (क) वर्णमाला, वर्णानाम् उच्चारणस्थानानि प्रयत्नाश्च; (ख) भाषाविज्ञानस्य सामान्यः

परिचयः, भाषापरिवर्तनस्य कारणानि, अर्थपरिवर्तनस्य कारणानि च

अनुशंसितग्रन्थाः -

1. उव्वट-महीधर, शुक्लयजुर्वेदभाष्य, मोतीलाल बनारसीदास, दिल्ली, 2007
2. स्वामी दयानन्द सरस्वती, यजुर्वेदभाष्य, सम्पा० ब्रह्मदत्त जिज्ञासु, रामलाल कपूर ट्रस्ट, सोनीपत (हरियाणा)

3. तैत्तिरीयोपनिषद्, हिन्दी व्याख्याकार - स्वामी प्रखर प्रज्ञानन्द सरस्वती, काशी, 2013
4. भर्तृहरि, नीतिशतक, सम्पादक एवं हिन्दी व्याख्याकार - जनार्दन शास्त्री पाण्डेय, मोतीलाल बनारसीदास, दिल्ली, 2014
5. नीतिशतकम्, 'नीतिपथ' हिन्दी व्याख्याकार - राजेश्वर शास्त्री मुसलगाँवकर, चौखम्भा, वाराणसी
6. श्रीमद्भगवद्गीता (हिन्दी अनुवाद सहित), गीता प्रेस, गोरखपुर, 2015
7. श्रीकृष्ण त्रिपाठी, श्रीमद्भगवद्गीता (द्वितीय, तृतीय एवं चतुर्थ अध्याय), 2005
8. देवीदत्त शर्मा, भाषिकी और संस्कृत भाषा, हरियाणा साहित्य अकादमी, चण्डीगढ़, 1990
9. कपिलदेव द्विवेदी, भाषा-विज्ञान एवं भाषा-शास्त्र, विश्वविद्यालय प्रकाशन, चौक, वाराणसी, 2012
10. कर्णसिंह, भाषाविज्ञान, साहित्य भण्डार, मेरठ
11. Burrow, T., The Sanskrit Language, 2016
12. Gune, P.D., An Introduction to Comparative Philology, Oriental Book House, Poona, 1958
13. The Taittirīya Upaniṣad, Eng. Tr. and Commentary by Swami Muni Narayana Prasad, D.k. Print world (P), Ltd., New Delhi-2009
14. The Nīti and Vairāgya śatakas of Bhartrihari, M.R. Kale, Motilal Banarsidass, Delhi, 2017

