## MATHEMATICS

## CORE PAPER - XIII
## NUMBER THEORY
## (120 Hours)

**SUBJECT CODE**

**Unit 1:** Divisibility – Euclidean algorithm – primes – Fundamental theorem of arithmetic.

**Unit 2:** Congruences – Fermat, Euler and Wilson theorem – Lagrange theorem – Chinese remainder theorem – Solution of congruences – Properties of the Euler function – Prime modulus – Power residue.

**Unit 3:** Quadratic residues – Gauss lemma – Quadratic reciprocity – Jacobi symbol.

**Unit 4:** Greatest integer function – Arithmetic function – Moebius inversion formula, recurrence relations.

**Unit 5:** Diophantine Equations – Solution of equations of the form $ax + by = c$, $x^2 + y^2 = z^2$, $x^4 + y^4 = z^4$ and $ax^2 + by^2 + cz^2 = 0$.

## REFERENCES


1. G.E Andrews (1992). *Number theory*, Hindustan publishing corporation.
2. T.M. Apostal (1980). *Introduction to analytic number theory*, Narisa publishing house.
3. D.M. (1993). *Burton Elementary number theory*, Universal book stall,
4. I. Niven and H.S. Zuckerman, (1984). *An introduction to the theory of numbers*, Wiley eastern.
5. Hall. H.S., and Knight. S.R. (1994). *Higher algebra.* HM Publications.

**CORE PAPER - XIV**
**LINEAR PROGRAMMING**
**(120 Hours)**

**SUBJECT CODE**

**Unit 1:** Linear Programming problem – Graphical solution – Formulation of LPP – Simplex method.

**Unit 2:** Standard Maximization case – Minimization problem – Artificial variables – Big-M method – Two phase method.

**Unit 3:** Degeneracy – cycling in LPP – Application of simplex method – Revised Simplex method.

**Unit 4:** Concept of duality – Duality theorems – Duality and simplex methods – Dual simplex method – Sensitivity analysis.

**Unit 5:** Integer programming – Culty plane method – (Gomarian constraint).

**REFERENCES**


1. Kantiswarup, Gupta and ManMohan, (2016).*Operations Research*, Sultan Chand and Sons.
2. Kapoor, V.K.,(1997).*Operations Research*, Sultan Chand and Sons,
3. Goel and Mittal, S.K.,(1991).*Operations Research*, Pragati Prakashan,
4. Sharma,J.K.,(1997).Operations Research theory and application, Macmillan,
5. Dr. Paria. (1999). *Linear Programming, Transportation, Assignment Game.* Dr. Paria, Books and Allied (p) Ltd.

**CORE PAPER - XV**
**GRAPH THEORY**
**(120 Hours)**

**SUBJECT CODE**

**Unit 1:** Basic Concepts: Introduction – Graph models – Vertex degrees – Isomorphism – Subgraphs – The pigeonhole principle and Turan's theorem.

**Unit 2:** Connectedness: Connected and disconnected graphs – Center – Adjacency Matrix and Incidence Matrix – Operations on graphs.

**Unit 3:** Bipartite Graphs: Definitions and examples – Characterisation of Bipartite graphs – Trees.

**Unit 4:** Eulerian and Hamiltonian Graphs: Eulerian graphs – Hamiltonian graphs – Closure and Hamiltonian.

**Unit 5:** Directed Graphs – Definition and Basic Concepts – Connectedness in Directed Graphs – Tournaments.

Applications: Wine Bottle problem – Water Jug problem – Seating Arrangement problem – Teleprinter's problem.

**REFERENCES**


1. Murugan, M., (2003). *Introduction to Graph Theory*, Muthali Publishing House, Chennai,
2. Murugan, M., (2005). *Applications of Graph Theory*, Muthali Publishing House, Chennai
3. Narasingh Deo, (1974).*Graph Theory with Applications to Engineering and Computer Science*, Prentice-Hall of India,
4. Arumugam S. and Ramachandran, S.,(2001).*Invitation to Graph Theory*, Scitech, Chennai.

**CORE PAPER - XVI**
**NUMERICAL METHODS**
**(120 Hours)**

**SUBJECT CODE**

**Unit 1:** Solution of Numerical Algebraic and Transcendental Equations: The bisection method – Newtons method – Criterion of order of convergence of Newton's method – Regula false method – Gauss elimination – Gauss Jacobi – Gauss Seidal method.

**Unit 2:** Finite Differences: First and higher order differences – Forward and backward differences – Properties of operator – Differences of a polynomial – Factorial polynomial – Error propagation Operator E and $E^{-1}$ Relation among $\Delta$, E, $\delta$ and D – summation of series.

**Unit 3:** Interpolation: With equal intervals: Newton's forward – backward interpolation formula – Gauss forward – backward interpolation formula – Bessel's formula.

Unequal intervals: Divided differences – Newton's divided difference formula – Lagrange's interpolation formula – Inverse interpolation.

**Unit 4:** Numerical Differentiation and Integration: Newton's forward and backward differences to compute derivatives – Derivatives using Bessel's formula – Newton – Cote's formula – Trapezoidal rule – Simpson 1/3 and $3/8^{th}$ rule – Weddle's rule.

**Unit 5:** Difference Equations: Definition – Order and degree of difference equation – Linear difference equation – Finding complementary function – Particular integral – Simple applications.

**REFERENCES**


1. Kandasamy P., Thilagavathy K., Gunavathy K., (2006). *Numerical Methods*, S. Chand & Company Ltd., Edn.
2. Venkataraman.M.K., (1999).*Numerical Methods in Science and Engineering* National Publishing company V Edition.

**CORE PAPER - XVII**
**MECHANICS (APPLICATION OF MATHEMATICS)**
**(120 Hours)**

**SUBJECT CODE**

**Unit 1:** Forces acting at a point – Resultant and Components – Parallelogram law of forces – Triangle law of forces – Converse – Lami's theorem – resolution of a force – theorems of resolved parts – Resultant of any number of coplanar forces – Condition of equilibrium.

**Unit 2:** Forces acting on a rigid body – Parallel forces – Resultant of two like and unlike parallel forces – Moment of a force – Varigon's theorem – three forces acting on a rigid body and simple problems – Law of friction – Coefficient of friction, Angle of friction, Cone of friction – Problems.

**Unit 3:** Projectiles – Path of Projectile is a parabola – Range etc – Range of a particle projected on an inclined plane etc.

**Unit 4:** Impact, impulses – Impact in a fixed plane – direct and oblique impact S.H.M., Equation of motion – Composition of S.H.M's.

**Unit 5:** Central orbits – Components of velocity and acceleration along and perpendicular to the radius vector – Differential equation of a central orbit – Pedal equation.

**REFERENCES**


1. Venkatraman M.K., (1999). *Statistics*, Agasthiyar Publication.
2. Venkatraman M.K., (1999). *Dynamics*, Agasthiyar Publication.

**CORE PAPER - XVIII**
**COMPLEX ANALYSIS**
**(120 Hours)**

**SUBJECT CODE**

**Unit 1:** Geometry of Complex numbers – Elementary transformations – Bilinear transformations – Cross Ration – Fixed points of bilinear transformation.

**Unit 2:** Analytic function – Differentiability – The Cauchy Riemann equations – Harmonic functions – Conformal mappings.

**Unit 3:** Definite integral – Cauchy's theorem – Cauchy's integral formula – Cauchy's inequality – Morera's theorem – Lioville's theorem and fundamental theorem of algebra – Maximum modulus theorem.

**Unit 4:** Taylor's and Laurent's theorem – Zeros of an analytic function.

**Unit 5:** Singularities – Cauchy's residue theorem – Arguments theorem – Rouche's theorem.

**Unit 6:** Contour integration.

**REFERENCES**


1. Arumugam S., Thangapandian Isaac A., (2004).*Complex Analysis*, SCITECH Publications Private Ltd.
2. Shanthi Narayanan, (1999).*Complex Analysis*, S. Chand and Co.,

**CORE PAPER - XIX**
**OPERATIONS RESEARCH**
**(120 Hours)**

**SUBJECT CODE**

**Unit 1:** Assignment model – Formulation of assignment problem – Hungarian method – Knoig's theorem – Minimization type – Unbalanced type – Routing problem – Traveling salesman problem.

**Unit 2:** Transportation Problem – Introduction and mathematical formulation of TP – Initial basic feasible solution – Row minima method – Column minima method – Northwest corner method – Least cost method – Vogal's approximation method – Unbalanced transportation table.

**Unit 3: Game theory:** Two person zero sum games – The maximum and minimum values – saddle point – Games without saddle point – Mixed strategies – Solutions of 2x2 games – Graphical method – Method of dominance principles – LP method.

**Unit 4:** Inventory control – various costs – EOQ – with or without shortages – multi item Inventory model with constraints – price break in inventory.

**Unit 5:** Queuing theory – elements of queue – Poisson arrival and exponential service – Multiple servers – finite population and finite capacity.

**REFERENCES**


1. Kantiswarup, Gupta and ManMohan, (2016).*Operations Research*, Sultan Chand and Sons.
2. Kapoor, V.K., (1997). Operations Research, Sultan Chand and Sons.
3. Goel B.S. and Mittal S. K., (1991). Operations Research, Pragati Prakashan.
4. Sharma J.K., (1997).*Operations Research theory and application*, Macmillan.

**CORE PAPER - XX**
**COMBINATORICS**
**(120 Hours)**

**SUBJECT CODE**

**Unit 1:** Two Basic principles – Simple arrangement and selections with or without repetition – Distribution – Binomial Coefficients.

**Unit 2:** Generating functions – Calculating Coefficients of Generating functions – exponential generating function – Summation method – Partitions.

**Unit 3:** Recurrence relations – Divide and conquer relations – Derangement – Solution of linear recurrence relation.

**Unit 4:** Fibonacci number – Stirling number of first and second kind – Catalan number – Menage number.

**Unit 5:** Inclusion and Exclusion Principle – Pigeon hole principle – Ramsey theorem.

**REFERENCES**


1. Cohen D., (1978). *Combinatorics*, Wiley.
2. Hall M., (1968).*Combinatorial mathematics*, McGraw Hill.
3. Liu C.L., (1994).*Introduction to Combinatorial mathematics*, McGraw Hill.
4. Ryser H.J., (1965).*Combinatorial mathematics*, Carus Mathematical monograph.
5. Tucker A.W., (2000).*Applied Combinatorics*, Wiley.
6. Krishnamurthy, (1998).*Combinatorics*, PHI.
7. Balakrishnan V.K., (2005).*Combinatorics*, Schaums outline series, Tata McGraw Hill.

**CORE PAPER - XXI**
**FUZZY MATHEMATICS**
**(120 Hours)**

**SUBJECT CODE**

**Unit 1:** Crisp Sets – Fuzzy Sets – Basic Types – Basic Concepts – Characteristics and Significance of the Paradigm shift.

**Unit 2:** Additional properties of α-cuts – representations of fuzzy sets – Extension principle for fuzzy sets.

**Unit 3:** Fuzzy set operations – Fuzzy complements – Fuzzy intersections: t-norms – Fuzzy Unions: t-conorms – Combinations of operations – Aggregation operations.

**Unit 4:** Fuzzy Numbers – Linguistic variables – Arithmetic operations on intervals – Arithmetic operations on fuzzy numbers – Lattice of fuzzy numbers – Fuzzy Equations.

**Unit 5:** Fuzzy Decision Making – Individual Decision Making – Multi-person decision making – Fuzzy linear Programming.

**REFERENCES**


1. George J. Klir and Bo Yuan, (2002).*Fuzzy Sets and Fuzzy Logic Theory and Applications*, Prentice Hall of India,New Delhi.
2. George J. Klir, Tina. Folger A.,(2003). *Fuzzy Sets, Uncertainty and Informations*, Prentice Hall of India.

**CORE PAPER - XXII**
**OBJECT ORIENTED PROGRAMMING WITH C++**
**(120 Hours)**

**SUBJECT CODE**

**Unit 1:** Introduction to object oriented approach – Characteristics of OOP – Classes, objects, inheritance and overloading.

**Unit 2:** C++ console I/O – Conditional statements – Looping statements – Function overloading – Constructors and destructors – Friend and online functions – Static variables and functions.

**Unit 3:** Using pointers to objects, this pointer – New and delete operators – Operator overloading – Overloading unary and binary operators using friend functions and member functions.

**Unit 4:** Inheritance – Levels of inheritance – Multiple inheritance – Multilevel inheritance – Virtual base classes – Pointers to derived classes – Virtual functions – Polymorphism.

**Unit 5:** Files – Templates – Exception handing.

**REFERENCES**


1. Balagurusamy E., (2002).*OOP with C++*,Tata McGraw Hill, New Delhi.
2. H. Schildt, *Teach yourself C++,* McGraw Hill.

# PHYSICS

## CORE PAPER –V
## OPTICS
## (120 Hrs)

**SUBJECT CODE:**

**Objectives:**

The key objectives of this paper are

- To learn the basic concepts, theories and laws of ray optics and physical optics.
- To understand the various experiments and instruments based on the theories of ray optics and physical optics, particularly to study the optical instruments, interferometers, diffractometer and polarizer.
- To know about the laser theory, Fiber optic principles and devices associated with laser and optical fibers.

**UNIT – I: GEOMETRICAL OPTICS(24hrs)**

Convex lens - Optic Centre - Cardinal Points - Principal foci and principal points - Optic centre of a lens - - Eye pieces: Huygens and Ramsden -Telescope: Refracting Astronomical - Reflecting Astronomical - Reflecting telescopes - Spherical aberration and lenses - Methods of minimizing spherical aberration - Condition for minimum spherical aberration in the case of two lenses separated by a distance - Chromatic aberration in lenses - Condition for achromatism of two thin lenses (in contact and out of contact) - coma - astigmatism - Constant deviation spectrometer - calculation of characteristic wave number of spectral lines.

**UNIT – II: INTERFERENCE(24 hrs)**

Coherent sources - Fresnel's Biprism - Theory of thin films - Air wedge - Determination of diameter of a thin wire by air wedge -Colours of Thin Film - Newton's rings - Determination of the wavelength of the sodium light - Refractive index of a liquid - Michelson Interferometer –- Theory – Applications-Jamin'sRefractometer - Rayleigh's Refractometer - Fabry Perot Interferometer.

**UNIT – III: DIFFRACTION (24 hrs)**

Fresnel assumptions - Rectilinear propagation of light - Zone plate - Fresnel and Fraunhofer Diffraction - Fresnel Diffraction at a Straight edge and Narrow wire - Fraunhofer Diffraction at a Single slit and Double slit - Missing orders in a Double slit, Diffraction pattern-Plane Transmission grating - Dispersive power of gratting -Overlapping spectra Rayleigh's criteria - Resolving power of telescope and grating

**UNIT – IV: POLARISATION (24 hrs)**

Polarisation - Double refraction - Nicol prism - Huygen's theory for uniaxial crystals - Quarter wave plate and half wave plate - Production and detection of Plane, Circularly and Elliptically Polarized light - Babinet's compensator - Optical activity - Fresnel's Explanation of optical rotation – Experimental verification - Specific rotation: Laurent's half shade polarimeter. - Kerr effect and Faraday effect.

**UNIT – V: LASERS AND FIBRE OPTICS (24 hrs)**

**Lasers: Laser action -** Induced absorption - spontaneous emission and stimulated emission – ruby laser-He-Ne laser– semiconductor laser.

**Fibre Optics** : Introduction – optical fibre – optical fibre system – optical fibre cable – total internal reflection – propagation of light through and optical fibre - critical angle of propagation – acceptance angle – numerical aperture – skip distance and number of total internal reflections – classification of optical fibres – The three types of fibres - single mode

step index fibre – multimode step index fibre – graded index fibre –fibre optic communication system – merits of optical fibres.

**REFERENCES**


1. BrijLal, M.N Avadhanulu and Subramaniam N (2012). *A text book of Optics*, New Delhi, S Chand & Co.
2. Murugeshan, (2012).*Optics and Spectroscopy*, New Delhi,S Chand & Co. Pvt. Ltd.,
3. Ajoy K. Ghatak,(2014). *Modern optics*, New Delhi, McGRaw Hill Inc.,
4. Jenkins A Francis and White E Harvey(1976).*Fundamentals of Optics,* McGRaw Hill Inc, New Delhi.
5. http://physicsdatabase.com/free-physics books/
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7. http://www2.warwick.ac.uk/fac/physics/teach/module/home/px207

**CORE PAPER –VI**
**ATOMIC PHYSICS AND SPECTROSCOPY**
**(120 Hrs)**

**SUBJECT CODE:**

**Objectives:**

Students know the structure of the atom, atomic models, laws of optical spectra, characteristics of rays and spectroscopic techniques.

**UNIT-I: STRUCTURE OF THE ATOM (24 hrs)**

Introduction- Rutherford experiments on α particle scattering- Experimental verification- -Bohr atom model – Critical potentials - atomic excitation – Experimental determination of critical potentials - Franck and Hertz method – Davis and Goucher's method - Mass spectrograph: Aston's mass spectrograph – Dempster's mass spectrograph.

**UNIT- II: ATOM MODEL (24 hrs)**

Sommerfeld's relativistic atom model – The Vector atom model – Quantum numbers associated with the vector atom model –The Pauli's exclusion principle – various quantum numbers - angular momentum and magnetic moment -magnetic dipole moment – Coupling schemes – L-S coupling –J J coupling – special quantisation Bohr magnetron -The stern and Gerlach Experiment – Spin orbit coupling.

**UNIT- III: OPTICAL SPECTRA (24 hrs)**

Spectral terms and notations - selection rules - fine structure of sodium D lines - alkali spectra - fine structure of alkali spectra - spectrum of Helium.

Zeeman effect – Larmor's theorem – Paschen back effect – Stark effect – Production of X-rays – Bragg's law – Bragg's X-ray spectrometer – X- ray spectra – Characteristics of X-ray spectra – Mosley's law – Compton effect – Photo electric effect – Experimental investigation – Einstein's Photo electric equation – Photo voltaic cell

**.UNIT- IV: MOLECULAR SPECTRA AND RAMAN EFFECT (24 hrs)**

**Molecular spectra:** Introduction – Origin of molecular spectra – Nature of molecular spectra – Rotation of linear system – Non rigid rotator -Theory of the origin of pure rotational spectrum of a molecule – Electronic spectra of molecule.

**Raman Effect:** Experimental study of Raman effect – Quantum theory of Raman effect – applications- Laser Raman spectroscopy - Classical theory of Raman effect - vibrational Raman spectra of diatomic molecules.

**UNIT-V: SPECTROSCOPIC TECHNIQUES (24 hrs)**

The energy of a diatomic molecule – vibrating diatomic molecule as a harmonic oscillator - spectroscopic techniques – constant deviation spectrograph – recording the spectrum – UV spectroscopy – Quartz spectrograph for near UV region - Infra red spectroscopy – absorption spectroscopy – Double beam IR spectrometer –Raman spectroscopy – Raman spectrometer.

**REFERENCES**


1. Murugeshan R., KiruthigaSivaprasath, (2008).*Modern Physics*, New Delhi S. Chand & Co.,
2. Sehgal D.L., Chopra K.L.and Sehgal N.K.. (1991). *Modern Physics*, New Delhi, Sultan Chand & Sons
3. Rajam J.B., (2004). *Atomic Physics,* New Delhi ,S. Chand & Co., 20th Edition,
4. Subrahmanyam N. and BrijLal, (2000). *Atomic and Nuclear Physics* , NewDelhi , S. Chand & Co.
5. Guptakumar Sharma , (2011).*Elements of Spectroscopy*, Meerut, Pragatiprakashan,,
6. Gurdeep Chatwaland, *Spectroscopy,* ShamAnand
7. White (2003). *Atomic specra* ,Ney York,McGraw Hill Intl. Book Company
8. Semat H. and Albright J.R., (2003). *Atomic and Nuclear Physics* , Chapmanand Hall
9. http://physicsdatabase.com/free-physics books/

10. http://bookboon.com/en/physics-ebooks
11. http://www2.warwick.ac.uk/fac/physics/teach/module/home/px207

**CORE PAPER –VII**
**MATHEMATICAL PHYSICS**
**(120 Hrs)**

**SUBJECT CODE:**

**Objectives:**

To understand the basics of vector calculus, matrices ,Laplacetran forms and statistics. With these background, students are made to gain the knowledge of concept of theoretical/analytical physics oriented courses like like classical mechanics ,quantum mechanics, electromagnetic theory and its applications.

**UNIT – I: VECTOR CALCULUS(24 hrs)**

Gradient of a Scalar field – line, surface and volume integral – Divergence of a vector function –examples – Curl of a vector function – Important vector identities – Gauss divergence theorem – Stoke's theorem.- Green's theorem – examples.

**UNIT – II: MATRICES(24 hrs)**

Eigen values and Eigen functions-Determination of eigen values and eigen vectors of the matrix-problems- Cayley - Hamilton theorem- determination of inverse matrix using Cayley –Hamilton theorem- statement and proof- determination of characteristic equation of matrix, verification .Theorems on eigen values and eigen vectors. Diagonalisation of matrix -Solution of quadratic equations by matrix method.

**UNIT –I II: MATRICES FOR PHYSICS(24 hrs)**

Special types of matrices –diagonal matrix,scalar matrix, identiy matrix, upper/lower triangular matrix-transpose of a matrix-properties-complex-conjugate matrix-properties-Hermitian Conjugate- Hermitian matrix-skew –Hermitian matrix- Properties of unitary and orthogonal matrices-adjoint of a matrix- Inverse of a matrix-problems-non-homogeneous linear equations solving system of equations by matrix method- Cramers rule for solving equations –examples-linear transformations-unitary and orthogonal trans formation-Hermitian forms-diagonalisation of 3x3 symmetric matrices.

**UNIT – IV: LAPLACE TRANSFORMS(24 hrs)**

Laplace transform:Definition –Laplace transform of L{1}. L{t}. L{eat}. L{e-at}. L{sinat}. L{cosat}. L{sinhat}. L{coshat}.Laplace transform of tsinat, tcosat,$e^{at}$coswt, $e^{at}$sinwt, properties of Laplace transforms-methods of finding Laplace transform-direct method – series expansion method – differential equation method-Laplacetransformsof gamma function.

**UNIT – V: STATISTICS (24 hrs)**

Arithmetic mean-method of finding arithmetic mean –properties –examples –Median-median class-quartiles-deciles-percentiles- mode-empirical relation between mean,median and mode-geometric mean –harmonic mean-measures of dispersion-range –mean deviation-standard deviation –root mean square deviation –Calculation of standard deviation **.**

**REFERENCES**


1. Murugeshan R., (2008). *Mechanics and Mathematical Physics*, New Delhi, S. Chand & Co.,
2. Gupta B.D., (1997), *Mathematical Physics*, Vikas Publishing house
3. SatyaPrakash , (2014*). Mathematical Physics with Classical Mechanics*, New Delhi, S. Chand & Co.,
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**CORE PAPER –VIII**
**CLASSICAL MECHANICS AND QUANTUM MECHANICS**
**(120 Hrs)**

**SUBJECT CODE:**

**UNIT – I: LAGRANGE'S FORMULATION (24 hrs)**

Mechanics of system of particles– Conservation theorem for linear and angular momentum - energy – Degrees of freedom – constraints – Generalized co-ordinates – transformation equations – Generalized displacement, velocity, acceleration, momentum and force – Principle of virtual work – D' Alembert's principle –-Lagrange's equation of motion from D'Alembert's Principles – Applications :linear Harmonic Oscillator, Simple Pendulum and Compound Pendulum.

**UNIT – II: HAMILTONIAN FORMULATION**

Phase Space – Hamiltonian function H- Hamilton's eqations- physical significance - Hamiltonian Principle – Hamilton's canonical equations of motion – Physical significance of H – Applications of Hamiltonian equations of motion of Simple Pendulum, Compound Pendulum and Linear Harmonic Oscillator.

**UNIT-III: FORMULATION OF QUANTUM MECHANICS(24 hrs)**

Inadequacy of classical mechanics - Black body radiation – plancks hypothesis- Photoelectric effect - Einstein's light quantum hypothesis and photoelectric equation - Matter waves - Phase and group velocity - wave packet - expressions for deBroglie wavelength - Davisson and Germer's experiment - G.P. Thomnsonexperiment - electron microscope

**UNIT-IV: WAVE MECHANICS(24 hrs)**

Wave function $\psi$ - significance of wave function $\psi$ -properties of wave functions- - Heisenberg's uncertainity principle - its consequences - - operator formalism - linear operators – adjoint operators - expectation values - eigen value and eigen function-Postulates of quantum mechanics

**UNIT-V: SCHRÖDINGER EQUATIONS AND ITS APPLICATIONS (24 hrs)**

Schrödinger equation - time dependent and time independent - application of Schrödinger equations - linear harmonic oscillator - zero point energy - particle in a one dimensional box - barrier penetration and tunneling effect - rigid rotator - hydrogen atom.

**REFERENCES**


1. Murugeshan R., (2008). Mechanics and Mathematical Physics, New Delhi ,S. Chand & Co.,
2. SathyaPrakash, (2010). Quantum mechanics by , Meerut, , PrgatiPrakashan,
3. Aruldas G., (2011). Quantum mechanics , New Delhi, PHI learning PVT Ltd.,
4. Gupta,B D., and SathyaPrakash, Classical Mechanics by KedarNath Ram Nath& Co.,
5. Ghatak A, (2002).Basic quantum mechanics ,New Delhi, McMillan India
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7. http://bookboon.com/en/physics-ebooks.

**CORE PAPER - IX**
**SOLID STATE PHYSICS**
**(120 Hrs)**

**SUBJECT CODE:**

**Objectives:**

To provide an in-depth foundation in solid state physics especially in crystallography, x-ray diffraction, phonons, magnetic, super dconductors and dielectric property of the solids.

**UNIT – I: CRYSTAL STRUCTURE(24 hrs)**

Crystal Structure –lattices – inverse lattice- X ray Diffraction - Bragg's Law - Miller Indices - Simple Crystal Structures - Calculation of number of atoms per unit cell – Atomic radius – co-ordination number – Packing factor for SC,BCC,FCC and HCP structures .

**Crystal imperfections –** Point defects – line defects –Surface defects – Volume defects.

**UNIT – II: ELECTRON THEORY OF SOLIDS(24 hrs)**

Electrical conduction- classification of conducting materials – Drude Lorentz theory – Expression for electrical conductivity – Thermal conductivity – Expression for thermal conductivity – Wiedemann – Franz law – classical free electron theory advantages and Draw backs.

**UNIT – III: DIELECTRIC MATERIALS(24 hrs)**

Dielectric constant - Different types of dielectric polarization – Frequency and temperature effects on polarization – Dielectric loss – Dielectric break down – local fields – ClausiusMosotti relation.

**UNIT – IV: SUPERCONDUCTORS(24 hrs)**

Super conductivity : Introduction –phenomenon of superconductivity – Properties of Superconductors – Type I and Type II Superconductors – High Tc Superconductors.

**Qualitative** – Meissner effect – Isotope effect – BCS Theory – A.C and D.c Josephson tunneling Application of superconductors: Electric generators, Electric power transmission line, Magnetic levitation.

**UNIT – V: NEW MATERIALS(24 hrs)**

Metallic glasses - Fiber Reinforced Plastics (FRP) and Fiber Reinforced Metals (FRM) - Metal matrix composites – Biomaterials – Ceramics – Shape memory alloys – SMART materials – conducting polymers.

**REFERENCES**


1. Pillai S.O., (2002).Solid State Physics ,New Delhi, New Age International Publishers,
2. Arumugam M., Material Science, Anuradha Agencies
3. Gupta S. L. & Kumar V., (1984). Solid state Physics,Meerut, K.Nath & Co,
4. Saxena Gupta Saxena, (2010) Solid State Physics,Meerut, Pragathiprakasan,
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**CORE PAPER –X**
**NUCLEAR PHYSICS**
**(120 Hrs)**

**SUBJECT CODE:**

**Objectives:**

- To enable the students to know the elements of nuclear structure and radioactivity
- To know the different nuclear models and to understand the elementary particles and their interactions.

**UNIT – I: RADIO ACTIVITY (24 hrs)**

Radio activity - Fundamental laws of Radio activity - Laws of Radioactive disintegration - Half life - Mean life - Laws of Successive disintegration – Radioactive dating – The age of earth – radioactive series – Alpha emission – properties of alpha particles – alpha spectrum – Geiger Nuttal law – Beta decay – Properties of Beta decay – Gamma ray spectrum – Determination of the wavelength of gamma rays.

**UNIT – II: NUCLEAR ACCELERATORS AND DETECTORS(24 hrs)**

Linear accelerator (LINAC) – Betatron – Synchroton – Proton Synchroton – Ionization chamber – GM counter – Wilson's cloud chamber – Bubble chamber – Spark chamber - Scintillation counter – Cerenkov counter

**UNIT- III: NUCLEAR PROPERTIES AND MODELS(24 hrs)**

Classification of nuclei - General properties of nucleus – Binding energy – Nuclear stability - Theories of nuclear composition – Nuclear forces - Proton-electron hypothesis – Proton-neutron hypothesis – Models of nuclear structure – The Liquid drop model – The Shell model – The Collective model.

**UNIT – IV: NUCLEAR REACTIONS (24 hrs)**

The Discovery of artificial transmutation – The Q-value equation for a Nuclear reaction – Types of nuclear reactions – Energy balance in nuclear reactions and the Q-value – Threshold energy of an endoergic reaction – Nuclear fission – critical mass – chain reaction – Nuclear fusion – source of stellar energy - Transuranic elements.

**UNIT- V: COSMIC RAYS AND ELEMENTARY PARTICLES(24 hrs)**

Discovery of cosmic rays – latitude effect – Azimuth effect – Altitude effect – Primary and Secondary cosmic rays – cosmic ray showers – Discovery of positron – the mesons – Van allen belts.

Elementary Particles: Classification – Particles and anti particles – the fundamental interactions.

**REFERENCES**


1. Murugesan. R, (2007).*Modern physics*,New Delhi, S.Chand&co
2. Pandiya and Yadav,(1997). *Elements of Nuclear Physics,*Kedar Nath Ram Nath, Meerut
3. Pandiya and Yadav, (2003). Elements of Nuclear Physics ,New Delhi, Himalaya Publishing.
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5. http://bookboon.com/en/physics-ebooks

**CORE PAPER –XI**
**RELATIVTY AND SPACE PHYSICS**
**(120 Hrs)**

**SUBJECT CODE:**

**OBJECTIVES**

To know about celestial bodies, the theories of the evolution of the universe and to understand the concept of relativity and their applications .

**UNIT – I: RELATIVITY(24 hrs)**

Michelson-Morley Experiment - Galilean Transformationand Newtonian Relativity - Inadequacy of Galilean Transformation - Fundamental Postulates of Special Theory of Relativity - Lorentz Transformation Equations - Length Contraction and Time Dilation –Law of Addition of Velocity- Variation of Mass with Velocity -Equivalence of Mass and Energy.

**UNIT –II: UNIVERSE(24 HRS)**

Planets- interior planets – exterior planets – crust, mantle and core of the earth –different region of the earth – rotation of the earth – magnetosphere – van Allen belts – Aurora.- Comets – periodic comets – salient features of asteroids and meteors.

**UNIT –III: SUN(24 hrs)**

Structure of photosphere, chromosphere, corona – – Mass of the sun-Surface temperature – sunspots- solar fares- solar prominences – satellites of planets – structure, phases and their feature of moon.

**UNIT –1V: STARS(24 HRS)**

Constellations – binary stars – origin and types of star clusters – Globular clusters – types of variable stars – Physical Properties of Stars-Masses of stars-Stellar Evolution types of galaxies-Milky Way Galaxy.

**UNIT –V: ASTRONOMICAL INSTRUMENTS AND ORIGIN OF UNIVERSE(24 HRS)**

Solar system-Astronomical Instruments-Refracting telescope-Reflecting telescope-Radio telescope measurement of distance-Size-Rotation Hubble, s law – Hubble telescope - Atmosphere Big-bang theory -pulsating theory – steady state theory - Expanding Universe.

**REFERENCES**


1. BaidyanathBasu, (2003). *An introduction to Astrophysics*, New Delhi, Prentice Hall India.
2. K.D. Abyankar , Astrophysics of solar system by University press, India.
3. The fascinating Astronomy, published by devadas telescopies, Chennai.
4. www.gascwbgr.org
5. http://bookboon.com/en/physics-ebooks

**CORE PAPER –XII**
**PROGRAMMING IN C WITH PHYSICS APPLICATIONS**
**(120 Hrs)**

**SUBJECT CODE:**

**Objectives:**

To Know about the techniques and applications of C Programming and to solve the Physics problems using C-programming techniques and to improve the science concepts based programming skills.

**UNIT – I: C LANGUAGE FUNDAMENTALS(24 hrs)**

History of C language - Basic Structure of C Programming - Character set - Constants - Variables - Data Types - Operators and Expression - Escape Sequence Characters -Library Functions - Input and Output statements: scanf - printf - getchar - putchar - gets – puts.

**UNIT – II: CONTROL STRUCTURES (24 hrs)**

Arrays Variables – Assigning Data for Array - One, Two and Multi dimensional Array - Conditional control statement: if, else, nested if, switch case - Looping statement: while, do while, for, nested for- break - continue and Unconditional control statement: go..to statement.

**UNIT – III: FUNCTIONS,STRUCTURE AND UNIONS(24 hrs)**

Function declaration – argument – Call the function – Return statement - Type of functions - Recursive functions - Passing Array to functions - Automatic, Static, Register and External storage - Defining a structure – Declaring structure variables – Accessing structure members – Structure initialization – Structure within structures – Structures and functions – Unions – Size of structures.

**UNIT – IV: POINTERS AND FILES(24 hrs)**

Understanding pointers – Accessing the address of a variable – Declaring pointer variables – Initialization of pointer variables – Accessing a variable through its pointer – Pointer expressions

Defining and opening a file – Closing a file - Input/output operation in files – Error handling during I/O operations – Command line arguments.

**UNIT - V: PHYSICS APPLICATION PROGRAMS (24 hrs)**

Quadratic equations - Matrix multiplication - Conversion of temperature from C to F and F to C - Determination of G by Boy's Method - Young's Modulus - Uniform bending - Spectrometer - Refractive index & Dispersive power of prism - Newton's Rings - Radius of curvature - Determination of Velocity of light - Foucault's Rotating Mirror Method .

**REFERENCES**


1. Karthikeyan E., (2008). A textbook on C, New Delhi,Prince–Hall of India Pvt, Ltd, ,
2. Balagurusamy E., (2004). *Programming in ANSI C*, New Delhi,Tata McGraw Hill
3. YeshavantKanitkar,(2002). *Let us C*, New Delhi, BPB publications,
4. https:// bponline.com
5. http://bookboon.com/en/physics-ebooks

**CORE PRACTICAL - III**
**(120 Hours)**

**SUBJECT CODE:**

**Any 12 experiments:**

1. Spectrometer – i -i' curve
2. Spectrometer – Cauchy's constant
3. Spectrometer - μ of a glass prism - i-d Curve
4. Spectrometer - Grating N and λ - minimum deviation method
5. Newton's Rings - Refractive Index of Liquid
6. Newton's rings – radius of curvature of a lens.
7. Air wedge - Thickness of a wire
8. Kundt's Tube – Determination of velocity of sound
9. Comparison of emfs of the given cells using B.G.
10. Ballistic Galvanometer – Figure of merit
11. Potentiometer – High range voltmeter
12. Hartley oscillator
13. Colpitt's oscillator
14. FET characteristics
15. Band gap energy of the semiconductor
16. Laser Diffraction – Determination of wave length of the diode laser
17. Resolving power of a lens using He-Ne laser
18. Verification of Malus law using diode laser
19. Astablemultivibrator using 555 timer.

**REFERENCES**


1. Srinivasan S., (2005). *A Text Book of Practical physics*, New Delhi, S. Sultan Chandpublications.
2. Sasikumar R.,(2011). *Practical Physics*, New Delhi,PHI Learning Pvt. Ltd, ,
3. https//www.practicalphysics.org.

**CORE PRACTICAL -IV**
**(120 Hours)**

**SUBJECT CODE:**

**Any 12 experiments:**

**8085 MICROPROCESSOR PROGRAMMING:**

1. Program to transfer data between memories
2. Program to find the 1's and 2's complement of 8 - bit data
3. Program to perform 8 – Bit Addition and Subtraction
4. Program to perform 8 –Bit Ascending order
5. Program to perform 8 –Bit Descending order
6. Program to perform 8 –Bit Multiplication
7. Program to perform 16 Bit Addition
8. Program to perform BCD Addition
9. Program to find the smallest and largest in a data Array

**C – PROGRAMMING in Physics**

1. Conversion of temperature from $^0$C to $^0$F and $^0$F to $^0$C
2. Determination of 'G' by Boy's Method
3. Young's Modulus - Uniform bending
4. Spectrometer - Refractive index & Dispersive power of prism
5. Newton's Rings - Radius of curvature
6. Determination of Velocity of light - Foucault's Rotating Mirror Method
7. Determine the Square root of the Quadratic equations
8. Matrix multiplication of a given 2 x 2 matrices
9. Determination of escape Velocity of a satellite

**REFERENCES**


1. NagoorKani A, (1999).*Microprocessor and its applications*, RBA Publication, Chennai.
2. Balagurusamy E., (2004). *Programming in ANSI C*, New Delhi,Tata McGraw Hill.

## CHEMISTRY

## CORE PAPER V
## INORGANIC CHEMISTRY – I
## (120 Hrs)

**SUBJECT CODE:**

**UNIT- I**

Coordination chemistry - terminology, classification of ligands, chelation, nomenclature of complexes, Werner's theory and Effective Atomic Number (EAN) concept.Isomerism in complexes-structural isomerism-coordination, ionisation, hydrate, ligand and linkage isomerism. Stereoisomerism-geometrical isomerism in 4 coordinated complexes – $Ma_2b_2$, $Ma_2bc$, $M(ab)_2$ and 6 coordinated complexes - $Ma_4b_2$, $Ma_3b_3$, $M(aa)_2b_2$. Optical isomerism and conditions for optical isomerism- optical isomerism in 6 coordinated complexes - $M(aa)_3$ and $M(aa)_2b_2$.

**UNIT – II**

Theories of metal - ligand bonding in complexes - valence bond theory (VBT), formation of outer orbital and inner orbital complexes, magnetic behaviour of the complexes and limitations of VBT. Crystal field theory (CFT) - crystal field splitting in octahedral and tetrahedral complexes. Strong and weak ligands, factors affecting $\Delta_o$ values, spectrochemical series, high spin and low spin complexes. Application of CFT to magnetic properties and colour of complexes, crystal field stabilisation energy (CFSE) and its uses.Limitations of CFT.Comparison between VBT and CFT.

**UNIT – III**

Applications of coordination compounds in quantitative analysis - gravimetric estimation of nickel using DMG and aluminum using oxine, estimation of hardness of water using EDTA.Structures and functions of chlorophyll and hemoglobin. Metal carbonyls-general methods of preparation, nature of M-CO bond, structure of $Ni(CO)_4$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Mn_2(CO)_{10}$ and $Co_2(CO)_8$.

**UNIT – IV**

Calculation of number of atoms in simple cubic (SC), face centered cubic (FCC) and body centered cubic (BCC) unit cells. Symmetry in crystals - symmetry operations and symmetry elements - plane of symmetry, axis of symmetry and centre of symmetry.Symmetry elements of a cubic crystal.Semiconductors - intrinsic and extrinsic - n-type and p-type.Electron gas theory and band theory of metals.

**UNIT – V**

Alloys - simple mixtures, solid solutions, substitutional and interstitial alloys. Hume - Rothery ratios and their applications. Structure of the ionic crystals - AX type - NaCl, CsCl and ZnS -(zinc blende and wurtzite structures), $AX_2$ type - $CaF_2$ and $TiO_2$. Limiting radius ratio rule- coordination number and shape of the ionic crystals. Defects in crystal structures: stoichiometric defects - Schottky and Frenkel defects. Non - stoichiometric defects-metal excess and metal deficiency defects.

**REFERENCES**


1. Puri, B.R. and. Sharma, L.R, (2011). *Principles of Inorganic Chemistry*, Delhi, Milestone publishers & distributors.
2. Madan, R.D., (2008). *Modern Inorganic chemistry*, New Delhi, S. Chand & Company Private Limited.
3. Malik, W.U., Tuli, G.D., and Madan, R. D., (2001). *Selected Topics in Inorganic Chemistry*, New Delhi, S. Chand & Company Private Limited.
4. http://www.askiitians.com/revision-notes/chemistry/coordination-compounds/
5. http://www.sparknotes.com/chemistry/organic1/orbitals/section1.rhtml
6. http://www.brainkart.com/article/Extrinsic-semiconductor--N-and-P--type-semiconductor_2979/
7. https://www.youtube.com/watch?v=MV-o_8ohB2o

**CORE PAPER VI**
**ORGANIC CHEMISTRY - I**
**(120 HRS)**

**SUBJECT CODE:**

**UNIT I**

Preparation and properties of benzene suphonic acid and suphanilic acid.Preparation and bacterostatic action of sulphanilamide. Phenol - preparation, resonance structures, bromination, nitration, oxidation, reduction, Schotten-Baumann, phthalein fusion and coupling reactions. Mechanisms of Reimer-Tiemann and Kolbe-Schmidt reactions.Tests for phenol.Preparation and properties of o-cresol, catechol, resorcinol and pyrogallol.

**UNIT II**

Preparation and properties of formic and acetic, benzoic, oxalic and malonic acids.Action of heat on formic, acetic, oxalic, malonic and succinic acids.Mechanism of hydrolysis of esters by $B_{AC}2$ and $A_{AC}2$.Diethyl malonate - preparation and synthesis of acetic acid, adipic acid, cinnamic acid, glycine and malonyl urea from diethyl malonate. Ethylacetoacetate - preparation and synthesis of succinic acid, crotonic acid, butanone, 4-methyl uracil and antipyrine from ethylacetoacetate.

**UNIT III**

Preparation of nitrobenzene.Reduction of nitrobenzene in acid, neutral and alkaline media.Electrolytic reduction of nitrobenzene.Preparation and properties of aliphatic primary, secondary and tertiary amines.Separation of amines by Hinsberg and Hofmann methods. Aniline - preparation and reactions. Basicity of aliphatic and aromatic amines.Preparation of benzene diazonium chloride, coupling reaction with aniline.Synthesis of phenol, benzene, benzoic acid, halo benzenes and nitrobenzene from benzene diazonium chloride.

**UNIT IV**

Heterocyclic compounds- preparation and reactions of pyrrole and pyridine.Comparison of basicities of pyridine and pyrrole.Synthesis and reactions of quinoline, isoquinoline and indole. Vitamins - classification, sources and deficiency diseases. Terpenoids-isolation and isoprene rule. Structural elucidation and synthesis of geraniol and α-terpeniol. Alkaloids - structural elucidation and synthesis of coniine and nicotine.

**UNIT V**

Molecular rearrangements-mechanisms of Pinacol-pinacolone, Beckmann, benzidine, Hoffmann, Curtius, Schmidt, benzil - benzilic acid, Claisen, Cope, Fries and Wolf rearrangements. (Applications not required)

**REFERENCES**


1. Bahl, B.S. and Arun Bahl, (2010). Advanced Organic Chemistry, New Delhi, S. Chand & Company Private Limited.
2. Agarwal, O.P., (2016). Reactions and Reagents, Meerut, Krishna Prakashan Media Private limited.
3. Jain, M.K., Sharma, S.C., (2017). Modern Organic Chemistry, Jalandhar, Vishal publishing company.
4. https://www.cliffsnotes.com/study-guides/chemistry/organic-chemistry-ii/summary-of-reactions/reactions-phenols

5. http://www.askiitians.com/iit-jee-carboxylic-acids-and-its-derivatives/general-methods-of-preparations.html
6. http://echemistry.in/preparation-of-amines-2/
7. https://www.britannica.com/science/heterocyclic-compound/Major-classes-of-heterocyclic-compounds

**CORE PAPER VII**
**PHYSICAL CHEMISTRY - I**
**(120 Hrs)**

**SUBJECT CODE:**

**UNIT – I**

Ohm's law and electrical units. Electrolysis – Faraday's law of electrolysis. Conductance of electrolytes - specific conductance, equivalent conductance and molar conductance - experimental determination of molar conductance.Types of electrolytes.Variation of specific and molar conductance with dilution. Transport number and ionic mobilities - determination of transport number - Hittorf's and moving boundary methods. Kohlrausch's law and its applications.Abnormal mobilities of hydrogen and hydroxyl ions.

**UNIT – II**

Arrhenius theory of electrolytic dissociation and its limitations.A qualitative discussion of interionic forces and their influence on conductance.Applications of conductance measurements - determination of solubility product, degree of dissociation, ionic product of water and conductometric titrations – acid-base and precipitation.Activity and activity coefficient of strong electrolytes (definition only).

**UNIT – III**

Dissociation of weak acids and bases – relative strengths.pH - definition, common ion effect and solubility product - applications of solubility product principle. Buffer solutions - types of buffers and buffer action - Henderson's equation. Hydrolysis of salts - hydrolysis constant and degree of hydrolysis of salts - weak bases and strong acids , weak acids and strong bases and weak acids and weak bases.

**UNIT – IV**

Electromotive force - electrochemical cells - galvanic cells - cell terminology - representation of cell - calculation of EMF of the cell.Reversible and irreversible cells - Weston standard cell.Experimental determination of EMF of a cell.Single electrode potential - determination.Electrochemical series - applications.Thermodynamic significance of electrode potential.Relation between EMF and thermodynamic quantities $\Delta G$, $\Delta H$, $\Delta S$ and their significance.Nernst equation for electrode and cell potentials. Types of electrodes - metal ion electrode, amalgam electrode, metal insoluble salt electrode (calomel and Ag/AgCl ),oxidation reduction electrode, gas electrode (standard hydrogen electrode).

**UNIT – V**

Concentration cells - types - derivation of EMF of concentration cells with and without transference. Liquid Junction potential - definition (derivation not necessary) and its elimination. Application of EMF measurements - potentiometric titrations - acid base, precipitation and redox titrations – determination of solubility of a sparingly soluble salt, determination of pH using glass, quinhydrone and hydrogen electrodes. Commercial cells – Acid storage battery. Rechargeable cells – nickel cadmium and lithium ion cells. Fuel cells.Electrochemical principle of rusting of iron.

**REFERENCES**


1. Puri, B.R. and Sharma, L.R, (2011), Principles of Physical Chemistry, Jalandhar, Vishal publishing company.
2. Arun Bahl, Bahl, B.S., and Tuli, G.D., (2012), Essentials of Physical Chemistry, Jalandhar, S. Chand Publishing.
3. Soni, P.L. and Dharmarha, O. P., (2016) Text Book of Physical Chemistry, New Delhi, Sultan Chand & Sons.
4. http://www.askiitians.com/iit-jee-chemistry/physical-chemistry/electrochemistry/
5. https://www.youtube.com/watch?v=6qqrdwlhJCI
6. https://www.slideshare.net/MadihahRamly/chapter-6-electrochemistry-49983898

**CORE PAPER VIII**
**INORGANIC CHEMISTRY-II**
**(120 Hrs)**

**SUBJECT CODE:**

**UNIT – I**

Covalency and oxidation number, difference between oxidation number and valency. Rules for calculating oxidation number.Oxidation and reduction, common oxidising agents and reducing agents.Equivalent weight of common oxidising and reducing agents. Balancing redox equations using oxidation number method. Extraction of Mn, Co and Ni.Preparation, properties and uses of potassium permanganate, potassium dichromate and ferrous sulphate.

**UNIT – II**

Occurrence, extraction, chemical properties and uses of boron.Preparation, properties, structure and uses of diborane, sodium borohydride, boric acid, borax and boron nitride-borax bead test.Borazine-preparation, chemical properties and structure – comparison of borazine with benzene.

**UNIT –III**

Compounds of silicon-quartz, tridymite, cristobalite and carborundum.Silicates-types, structures and uses.

Isolation of noble gases from liquid air-clathrate compounds-types and properties. Preparation, properties and structures of – $XeF_2$, $XeF_4$, $XeF_6$, $XeO_3$ and $XeOF_4$

Inter halogen compounds: preparation, properties, uses and structures of-ICl, IBr, $ICl_3$, $IF_5$ and $IF_7$.

**UNIT –IV**

Non-aqueous solvents-classification of solvents, characteristic properties of a solvent.Physical properties, chemical reactions, advantages and limitations of liquid ammonia, liquid hydrogen fluoride and liquid sulphur dioxide.

**UNIT –V**

Acids and Bases - Arrhenius concept, Lowry - Bronsted concept - conjugate acid - base pairs, Lewis concept. Relative strengths of acids and bases-effect of solvent, levelling effect-polarity and dielectric constant- effect of substituents-electron releasing, electron withdrawing nature of substituents, oxidation number of central atom, resonance effect. Hard and Soft Acids and Bases (HSAB) principle and their applications.

**REFERENCES**


1. Madan, R.D., (2008), Modern Inorganic chemistry, New Delhi, S. Chand & Company Private Limited.
2. Puri, B.R. and. Sharma, L.R, (2011), Principles of Inorganic Chemistry, Delhi, Milestone publishers & distributors.
3. Soni, P.L. and Dharmarha, O. P., (2016) Text Book of Physical Chemistry, New Delhi, Sultan Chand & Sons.
4. www.adichemistry.com
5. signoftruth.vom>non-aqueous-solvents
6. www.britannica.com>science>borum.
7. Chem..libretents.org.

**CORE PAPER IX**

**ORGANIC CHEMISTRY –II**

**(120 Hrs)**

**SUBJECT CODE:**

**UNIT-I**

Isomerism: structural and stereoisomerism - geometrical isomerism-Cahn – Ingold - Prelog rules for priority of groups, E-Z notation, determination of configuration of geometrical isomers by physical and chemical methods. Optical isomerism, plane polarized light, chirality, enantiomers, diastereomers, anomers, epimers, optical isomerism in lactic acid and tartaric acid. R-S configuration.

**UNIT-II**

Conformational analysis - distinction between conformation and configuration.Conformations and potential energy diagrams of ethane and n-butane. Conformations of cyclohexane- chair, half chair, boat and twist forms. Methyl cyclohexane, conformations and stabilities of 1,2 –dimethylcyclohexane, 1,3 –dimethylcyclohexane and 1,4 –dimethylcyclohexane, conformations in cyclohexanol, cyclohexane-1,3- diol and cyclohexane-1,4,-diol.

**UNIT-III**

Free radicals-classification, generation of free radicals, detection of free radicals, configuration of free radicals and relative stabilities of alkyl free radicals. Stability of triphenylmethyl free radical, reactions involving free radicals-polymerization, allylic bromination by NBS, autoxidation, Sandmeyer reaction, Gomberg and Ullmann reactions.

**UNIT-IV**

Addition reactions of alkenes - electrophilic, nucleophilic and free radical addition reactions. Mechanisms of addition of $H_2$, halogens and hydrogen halides to carbon – carbon double bond systems, Markovnikov's rule and Kharasch-peroxide effect, cis-hydroxylation and hydroboration. Synthetic uses of diazomethane and perbenzoic acid.

**UNIT-V**

Carbohydrates- classification - elucidation of open chain structure of glucose and fructose, mutarotation, interconversions between glucose and fructose, reducing and non-reducing sugars. Amino acids and proteins: Amino acids-classification and general methods of preparation and properties. Peptide synthesis by Bergmann method, proteins-classification, primary and secondary and tertiary structures. Colour test for proteins.

**REFERENCES**


1. Bahl, B.S. and Arun Bahl, (2010), Advanced Organic Chemistry, New Delhi, S. Chand & Company Private Limited.
2. Agarwal, O.P., (2016), Reactions and Reagents, Meerut, Krishna Prakashan Media Private limited.
3. Jain, M.K., Sharma, S.C., (2017), Modern Organic Chemistry, Jalandhar, Vishal publishing company.
4. https://www.youtube.com/watch?v=dORAZbvh6bI
5. http://nptel.ac.in/courses/104103022/download/module9.pdf

6. https://www.saddleback.edu/faculty/jzoval/mypptlectures/ch12_carbohydrates/lecture_notes_ch12_carbohydrates_current.pdf
7. http://cbc.chem.arizona.edu/classes/bioc460/spring/460web/lectures/LEC3_AminoAcids_08-ppt.pdf.

**CORE PAPER X**
**PHYSICAL CHEMISTRY-II**
**(120 Hrs)**

**SUBJECT CODE:**

**UNIT – I**

Chemical Kinetics: Definition of rate and rate constant, dimensions of rate and rate constant. Order and molecularity – differences.Derivation of rate constants for zero, first and second order reactions.Examples for fractional and higher order reactions. Various methods of determining order of a reaction. Effect of temperature on reaction rate, Arrhenius equation – calculation of energy of activation.

**UNIT – II**

Simple collision theory – its limitations and modifications.Lindemann theory of unimolecular reactions. A qualitative discussion of absolute reaction rate theory ( ARRT ) using HI reaction- significance of entropy of activation, comparison of collision theory with ARRT. Catalysis – definition, types, characteristics of catalytic reactions , catalytic promoter , catalytic poison, auto catalyst, negative catalyst and induced catalyst. Energy of activation and catalysis.Theories of catalysis. Enzyme catalysis, lock and key and Michaleis - Menton (Derivation not required) mechanisms.

**UNIT – III**

Phase rule – Definition of phase, component and degrees of freedom. Derivation of phase rule.Application of phase rule to one component systems – phase diagrams of $H_2O$, $CO_2$ and sulphur systems.Application of phase rule to two component systems – lead-silver and zinc-magnesium systems.Phase diagrams for two component liquid systems – completely miscible and partially miscible (Phenol-water, triethylamine-water and nicotine-water) systems..

**UNIT – IV**

Principle of steam distillation. Nernst distribution law and its applications Absorption and adsorption – definitions – physisorption and chemisorption – difference.Adsorption isotherms – theory and derivation of Frendulich and Langmuir isotherms.Ion exchange adsorption – cationic exchange and anionic exchange. Applications of ion exchange adsorption – water softening and deionization of water.

**UNIT – V**

Photochemical reactions. Difference between photochemical and thermochemical reactions. Laws of photochemistry – Lambert Beer's, Grotthus Draper law and Stark Einstein's law. Quantum yield – definition and experimental determination(actinometry). Photochemical reactions of low and high quantum yields.Kinetics of hydrogen-bromine and hydrogen-chlorine reactions.Photosensitization and quenching.Definition of chemiluminescence, fluorescence and phosphorescence.

**REFERENCES**


1. Puri, B.R. and Sharma, L.R, (2011), Principles of Physical Chemistry, Jalandhar, Vishal publishing company.
2. Arun Bahl, Bahl, B.S., and Tuli, G.D., (2012), Essentials of Physical Chemistry, Jalandhar, S. Chand Publishing.
3. Soni, P.L. and Dharmarha, O. P., (2016) Text Book of Physical Chemistry, New Delhi, Sultan Chand & Sons.
4. Gurdeep Raj, (2014) Advanced Physical Chemistry, Meerut, Goel Publishing house
5. http://chemed.chem.purdue.edu/demos/index.html
6. https://serc.carleton.edu/index.html
7. http://www.chemistrylearning.com/

**ELECTIVE PAPER - I**
**ANALYTICAL CHEMISTRY**
**(120 Hrs)**

**SUBJECT CODE:**

**UNIT -I**

Storage and handling of chemicals - corrosive, inflammable, explosive, toxic, poisonous and carcinogenic chemicals.First aid procedures for laboratory accidents involving toxic and poisonous chemicals, electrical shock, cuts and burns from hot objects.Laboratory cleansing methods and cleaning agents. Interchangeable glass ground joint apparatus and their advantages. Calibration and grading of pipette, burette and volumetric flask.

**UNIT -II**

Evaluation of analytical Data- Errors - types-determinate indeterminate and gross errors.Errors in measurements - weighing, measuring solutions, titrations and gravimetric analysis.Absolute error and relative error. Precision and accuracy, difference between precision and accuracy. Significant figures, mean, median and mode, average, deviation-standard deviation. confidence limits, Q-test, F- test and t-test. SI and derived units.

**UNIT -III**

Semimicro qualitative analysis - anions (interfering and non-interfering), reactions of some common anions (carbonate, sulphide, sulphate, nitrate, halides, oxalate, borate and phosphate), principle involved in the preparation of sodium carbonate extract and elimination of interfering anions. Classification of cations into groups, reactions of various cations, group reagents, solubility product and common ion effect.

**UNIT -IV**

Volumetric analysis - classification, standard solution, primary and secondary standard substances, concentration units.Acid-base titrations - choice of indicators and theory of acid base indicators.Redox titrations-self indicators and external indicators.Precipitation titrations - halides, thiocyanates, indicators of precipitation titrations.Complexometric titrations (EDTA titration only).

**UNIT -V**

Gravimetric analysis-methods of precipitation, conditions of precipitation, choice of precipitants.Types of organic precipitants, sequestering agents, solubility product and precipatation, factors affecting the solubility of precipitates, co-precipitation and post precipitation, procedure to minimise coprecipatation and post precipitation.Precipitation from homogeneous solution, Washing and drying of precipitates.

**REFERENCES**


1. Gopalan, R., Subramanian, P.S. and Rengarajan, K., (2004) Elements of Analytical Chemistry, New Delhi, Sultan Chand & Sons.
2. Srivastava, A.K., and Jain, P.C., (2009) Instrumental Approach to Chemical Analysis, Jalandhar, S. Chand Publishing.
3. Venkateswaran, V., Veeraswamy, R. and Kulandaivelu, A.R, (2006), Basic Principles of Practical Chemistry, New Delhi, Sultan Chand & Sons Private Limited
4. https://goo.gl/HDiSJP
5. https://www.slideshare.net/MarkSelby2/gravimetric-analysis-44916288
6. https://www.slideshare.net/bharat46083610/volumetric-analysis-79371821?qid=7d2d3cf8-43e3-465c-ae12-ab8db3fdd38e&v=&b=&from_search=4
7. http://www.academia.edu/5266578/Analytical_Chemistry_Lecture_Notes_

**ELECTIVE PAPER - II**
**SPECTROSCOPY**
**(120 Hrs)**

**SUBJECT CODE:**

**UNIT-1**

Spectroscopy, spectrometry and spectrum Atomic and molecular spectroscopy-absorption and emission spectra..Electromagnetic radiation, wavelength, wave number, frequency and energy.Regions of electromagnetic spectrum and absorption of radiation by organic molecules. Different types of molecular energies. Different types of molecular spectroscopy. Microwave spectroscopy-principle and theory.Diatomic molecule as a rigid rotor-selection rule-instrumentation.Applications of rotational spectroscopy-structures of xenon oxyfluoride and benzonitrile.

**UNIT-II**

IR Spectroscopy -theory-molecular vibrations-vibrational frequency-force constant-vibrational energy-zero point energy- vibrational degrees of freedom for liner and non-liner molecules and selection rules.Factor affecting Vibrational frequencies-coupled vibration, Fermic resonance and electronic effects.Instrumentation (block diagram only). Finger print region, overtones, combination and difference frequencies. Applications of IR spectroscopy-qualitative analysis (determination of functional groups)-distinction between two types of hydrogen bonding and study of keto-enol tautomerism.

**UNIT III**

Electronic Spectroscopy- Beer's and Lambert's law.Theory of electronic spectroscopy-types of electronic transitions.Franck- Condon principle, Chromophores and auxochormes. Absorption and intensity shifts- bathochromic, hypsochromic, hyperchromic, and hypochromic shifts. Types of absorption bands.Instrumentation (block diagram only). Woodward-Fieser rules for calculating $\lambda_{max}$ in conjugated and extended conjugated dienes and dienones. Application of electronic spectroscopy in the identification of configurations of geometrical isomers.

**UNIT IV**

NMR Spectroscopy-theory- number of signals-equivalent and non-equivalent protons.Instrumentation (block diagram only).Chemical shift and reference standard.Factors affecting chemical shift-shielding and deshielding-anisotropy with reference to ethylene, acetylene and benzene.Spin – Spin Coupling. Rules of splitting signals-splitting of signals in 1,1,2-tribromoethane, ethanol and acetaldehyde. Coupling constant (elementary idea only) NMR spectra of ethyl bromide, 2-chloropropane, acetamide, toluene and 1,4-dioxane.

**UNIT V**

Mass Spectrometry- basic principles and theory.Instrumentation- Single focusing mass analyser- presentation of mass spectrum. Nitrogen rule-isotopic peaks, metastable ions and peak, molecular ion peak, Base peak. McLafferty rearrangement and Retero Diels - Alder reaction.Fragmentation of alkanes,alkenes,alkenes,aliphatic aldehydes,ketones and alcohols

**REFERENCES**


1. Sharma, Y.R. (2013) Elementary organic Spectroscopy, New Delhi, S. Chand & Company Private Limited.
2. Jag Mohan, (2001) Organic Spectroscopy Principles and Applications, New Delhi, Narosa Publishing House
3. http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction#NMRSpectroscopy
4. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/spectro.htm
5. https://www.universalclass.com/articles/science/organic-chemistry/nmr-mass-spectrometry-and-infrared-spectroscopy.htm.

**CORE PRACTICAL – III**
**(240 Hours)**

**SUBJECT CODE:**

**A. Gravimetric Analysis**

1. Lead as lead chromate
2. Barium as barium chromate
3. Calcium as calcium oxalate monohydrate
4. Nickel as nickel dimethyl glyoxime complex
5. Magnesium as magnesium oxinate
6. Barium as barium sulphate (by insineration)
7. Lead as lead sulphate

**B. Physical Chemistry Experiments**

1. Determination of transition temperature of a hydrated salt
2. Determination of partition coefficient of Iodine between $CCl_4$ and $H_2O$
3. Determination of equilibrium constant for the reaction $KI + I_2 \rightleftharpoons KI_3$
4. Determination of critical solution temperature(CST) of phenol-water system
5. Determination of effect of impurity (NaCl) on CST of phenol-water system
6. Determination of effect of impurity (Succinic acid) on CST of phenol-water system
7. Determination of molecular weight by Rast's macro method
8. Phase diagram- simple eutectic system
9. Determination of rate constant of acid catalyzed hydrolysis of an ester
10. Kinetics of persulphate- Iodide reaction

**Electrochemistry Experiments**

11. Determination of cell constant
12. Determination of equivalent conductance of a strong and weak electrolyte.
13. Conductometric titration- strong acid vs strong base
14. Conductometric titration- weak acid vs strong base
15. Potentiometric titration- Redox reaction [ $KMnO_4$ vs Fe(II)]
16. Potentiometric titration- acid-base titration [HCl vs NaOH]

**C. Demonstration Experiments**

1. Polarimetry- Inversion of cane sugar

**REFERENCES**


1. Venkateswaran, V., Veeraswamy, R. and Kulandaivelu, A.R, (2006), Basic Principles of Practical Chemistry, New Delhi, Sultan Chand & Sons Private Limited.
2. Mani. P.K., Thomas, A.O., (1981), Practical Chemistry, Cannanore, Scientific Book Centre.
3. www.aiktcdspace.org>jspui>bitstream
4. https://www.tau.ac.il/~advanal/PotentiometricTitrations.htm
5. https://www.tau.ac.il>conductometry-titrations.

**BOTANY**

**CORE PAPER VI**

**CELL BIOLOGY AND MOLECULAR BIOLOGY**

**(120 Hrs)**

**SUBJECT CODE:**

**Unit I**

Introduction- scope- cell organisation- prokaryotic and eukaryotic. Cell boundaries- cell wall-gross layer i.e. middle lamella, primary wall, secondary wall- Structure, chemistry and functions of cell wall, pits- (simple and bordered), Plasmodesmata. Plasma membrane-occurrence, structure (fluid mosaic model) chemistry, function and origin. Occurrence, structure function and origin of Endoplasmic reticulum Golgi bodies, lysosomes, ribosomes, mitochondria and plastids.

**Unit II**

Ultrastructure and functions of Nucleus,nucleolus, chromosomes structure, euchromatin, heterochromatin, Polytene and lampbrush chromosomes-, cell inclusion.Cell cycle, Cell division, Mitosis and Meiosis- their significance.

**Molecular Biology**

**Unit III**

Nucleic acid as genetic material, nucleotide, structure of nucleic acid, Genetic code and its properties, mechanisms of protein synthesis.

**Unit IV**

Gene expression, initation, enzymes involved and termination of transcription. Translation – codon-anticodon. DNA damage and repairs

**UNIT V**

Regulation of gene expression in prokaryote operon concept-positive and negative regulation of lac operon

**REFERENCES**


1. Geraald Karp,(2010).*Cell biology,* John wiley and sons
2. Rrastoel, S.C, (1996). *Cell and Molecular Biology*- New age international publishers.
3. Verma, P.S., Agarwal, V.K.(1995).*Cell Biology, Genetics, Molecular Biology & evolution.*S.lChand
4. De Robertis, E.D.P.,DeRobertis, E.M.F.Jr., (1987).*cell and Molecular Biology* Lea Febiger.
5. Old and Primrose, (2000).*Principles of Gene manipulations,*Blackwell Scientific Publications.

**CORE PAPER VII**
**PHYSIOLOGY AND BIOCHEMISTRY**
**(120 Hrs)**

**SUBJECT CODE:**

**UNIT I**

Water relations of plants – Diffusion, Permeability, Osmosis , Mechanism of absorption of water-passive and Active transport, Transpiration – structure of stomata and mechanism of stomatal regulation, types and significance, factors affecting transpiration. Mineral salt absorption – passive absorption, active absorption- carrier concept, cytochrome pump theory, carrier mechanism involving ATP, Mineral Nutrition in plants – Macro and micro nutrients, Occurrence and functions of essential elements.

**UNIT II**

Photosynthesis – Radiant energy, Emerson's enhancement effect, Absorption spectrum, action spectrum, Light reaction, pathways of carbon fixation– Calvin Cycle, Hatch and Slack pathway, photorespiration, CAM pathway, factors affecting photosynthesis.

Respiration- Aerobic respiration and Anaerobic respiration, Glycolysis, Krebs cycle, electron transport system, mechanism of oxidative phosphorylation, cyanide resistant respiration, RQ, factors affecting respiration.

**UNIT III**

Nitrogen metabolism- significance of nitrogen, Nitrate reduction in plants, Nitrogen fixation-biological and non biological, biochemistry of nitrogen fixation, nitrogen cycle.

Enzymes- nomenclature and classification of enzymes, properties of enzymes, mechanism of enzyme action, factors affecting enzyme activity.

**UNIT IV**

Plant growth regulators – auxins, gibberllins, ethylene and abscisic acid, brief account of plant responses to growth regulators, photoperiodism and photomorphogenesis, phytochromes, vernalization, Seed physiology- dormancy, storage and germination of seed.

**UNIT V**

Plant Biochemistry- chemical bonds, buffers, pH, structure and types of carbohydrates-monosaccharides, oligosaccharides and polysaccharides, lipids- phospholipids, glycolipids and sterols, amino acids and proteins – classification of amino acids and proteins, structure of proteins.

**REFERENCES**


1. Tiaz L.,Zeiger.E., (2011), *Plant Physiology(3rd edition)* Benjamin/ Cummings Publishing Company Inc.
2. Jain V.K,(2010). *Fundamentals of plant physiology.* S Chand & Company Ltd.
3. Verma S.K,MohitVerma, (2007)*A text book of plant physiology, biochemistry and biotechnology.* S Chand & Company Ltd.
4. Srivastava. H.S, (2010), *Plant Physiology, Biochemistry and Biotechnology.*Rastogi publications.
5. Salisbury F.B, Ross C.W, (1991), *Plant Physiology,* CBS publishers and distributors.

**CORE PAPER VIII**
**GENETICS, PLANT BREEDING AND EVOLUTION**
**(120 Hrs)**

**SUBJECT CODE:**

**UNIT I**

Monohybrid and Dihybrid cross, test cross, back cross, Mendel's Laws. Deviation fromMendelian ratio – incomplete dominance, lethal factor, complementary factor, supplementary factor, duplicate and inhibitory. Polygenic inheritance – Inheritance of Wheat Kernel and ear length in Maize.

**Unit II**

Linkage – Crossing over and recombination. Gene Mapping. Chromosome theory of inheritance. Sex determination in plants, Sex Linked Inheritance, Sex linked diseases, Haemophilia, Colour blindness.

Extra nuclear inheritance - male sterility in corn, Population genetics, Hardy-Weinberg's principles, factors affecting.

**UNIT III: PLANT BREEDING**

Plant Breeding: Objectives, Plant introduction, selection, hybridization techniques, Hybrid Vigor, heterosis, Interspecific and intergeneric. Mutation -Polyploidy and its applications in plant breeding. Breeding for crop improvement for paddy, Groundnut and Sugarcane.

**UNIT IV**

Utilization of wild species in crop improvement, inter specific crosses, genomic analysis and evolution of polyploidy crops, cytoplasmic male sterility systems in hybrid seed production, somoclonal variations in crop improvement, nucleic acid hybridization and RFLP in crop improvement

**Evolution**

**Unit-V**

Origin of life-Spontaneous and biochemical theories-Theories of Organic evolution-Darwin, Lamarck ,deVeries and modern synthetic theory.Variation-sources-mutation.recombination.Adaptation and selection.

**REFERENCES**


1. Acquaah, G, (2007). *Principles of Plant Genetics & Breeding*. Blackwell Publishing.
2. Babcock, E.B., (2009),*Genetics & plant breeding*, Agrobios India.
3. Chaudhari, H.K, (1984),*Elementary Principles of Plant Breeding*. Oxford – IBH. 2nd edition.
4. Gardner EJ, Simmons MJ, Snustad DP (2008),*Principles of Genetics.* 8th Ed. WileyIndia.
5. Pierce B.A, (2011),*Genetics: A Conceptual Approach*, 4th Ed., Macmillan Higher Education Learning
6. Singh, B.D, (2005),*Plant Breeding: Principles and Methods.*Kalyani Publishers. 7th edition.
7. Snustad, D.P, Simmons, M.J. (2010),*Principles of Genetics,* John Wiley & Sons Inc., India. 5th edition.


III YEAR

**CORE PAPER IX**

**PLANT PATHOLOGY**

**(120 Hrs)**

**SUBJECT CODE:**

**Unit I**

Detailed studies of the nature of plant disease and its causal agents (fungi, bacteria, viruses, nematodes, environmental/chemical agents), and of symbionts and their effect on plant health and disease resistance.

**Unit II**

Common disease its symptoms, disease cycle and control measure. Rots- Late blight disease of potato, Damping off disease of seedlings, Downy mildew –peas, Wilt of cotton, Leaf spot disease of ground nut, Wheat Rust , Citrus canker.

**Unit III**

Host pathogen interactions, Parasitism/disease development and attack methods, Molecular mechanisms of pathogenesis, recognition phenomenon, penetration, invasion, primary disease determinant, Defense mechanism in plants- phytoalexins, Systemic Acquired Resistance (SAR)

**Unit IV**

Transgenic approach for crop protection, Elementary genetic engineering .Management of pathogen through satellite, antisense – RNA, Ribosomes, coat protein, hypo virulence cross protection, useful genes and promoter technology.Engineering chemicals that elicit defense response to plants

**Unit V**

Epidemiological considerations on disease spread and major outbreaks, and disease control and management techniques (including resistance phenomena and impact). Biosafety and bioethics in plant pathology,

Control of plant disease-Cultural, chemical, biological means

**REFERENCES**


1. Rangaswami, G.,Bhagyaraj, D.J, (2004), *Agricultural Microbiology* Prentice Hall of India (P) Ltd., New Delhi.
2. Sharam, P,(1996), *Plant Pathology*.Rastogi Publications, Meerut.
3. Rangaswami., G, Mahadevan, A,(2002), *Diseases of crop plant inIndia,* Prentice Hall of India (P) Ltd. New Delhi.
4. Trigiano, R.N., Windham,M.T.,Windham,A.S, (2003), *Plant Pathology: concepts and laboratory exercises*,CRC PresS
5. Pandey, B.P, (1999),*Plant Pathology,*S.Chand& Co., New Delhi.

6. Chatterjee P.B, (1997), *Plant Protection Techniques*,BharatiBhawan,Patna.
7. Arora J.S, (1990), *Introductory Ornamental Horticulture*, Kalyani Publications
8. Bailey L.H, (1991), *The Standard Cyclopaedia of Horticulture Vol 1,2& 3,* Mcmillan Publications.
9. Bose T.K,Mukerjee D, (1987), *Gardening in India*, Oxford Book House
10. Manibhushan Rao K, (1991), *Text Book of Horticulture*, Macmillan Publications.

**CORE PAPER - X**
**PLANT ECOLOGY AND ENVIRONMENTAL BOTANY**
**(120 Hours)**

**SUBJECT CODE:**

**Unit-I**

Approaches to the study of ecology (Autecology and Synecology).Plant environment: Climatic and edaphic factors.

**Unit-II**

Vegetation-Development of vegetation-migration, ecesis, colonization

Plant succession:Hydrosere and Xerosere.

Ecological classification of plants and their correlation to the habitat factors.Global biogeochemical cycles of carbon,nitrogen, phosphorous,and sulphur

**Unit-III**

Approaches to phytogeography-Vegetational types of Tamilnadu:Evergreen,deciduous,scrub and mangrove.

Approaches to biodiversity,conservation *insitu* and *exsitu* methods. Megacenters of biodiversity.

**Unit-IV**

Biological diversity:Concept and levels,Role of biodiversity in ecosystem function and stability;speciation and extinction:IUCN categories of threat: causes of biodiversity loss:conservation-Keystone Species. Conventional and nonconventional energy sources.

**Unit V**

Social Issues and the Environment • From Unsustainable to Sustainable development • Urban problems related to energy • Water conservation, rain water harvesting, watershed management • Resettlement and rahabilitation of people; its problems and concerns. Case Studies • Environmental ethics: Issues and possible solutions. • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. • Wasteland reclamation. • Consumerism and waste products. • Environment Protection Act. • Air (Prevention and Control of Pollution) Act. • Water (Prevention and control of Pollution) Act • Wildlife Protection Act • Forest Conservation Act • Issues involved in enforcement of environmental legislation. • Public awareness.

**REFERENCES**


1. Odum, E.P., (1998), *Fundamentals of Ecology*, Nataraj Publications
2. Agarwal, K.C, (2001),*Environmental Biology,*Nidi Publ. Ltd. Bikaner.
3. BharuchaErach, (1995), *The Biodiversity of India,*Mapin Publishing Pvt. Ltd., Ahmedabad.
4. Kormondy, E.J, (1996). *Concepts of Ecology*. Prentice Hall, U.S.A. 4th edition.
5. Sharma, P.D. (2010), *Ecology and Environment*,Rastogi Publications, Meerut, India. 8th edition.
6. Simpson, M.G. (2006). *Plant Systematics*. Elsevier Academic Press, San Diego, CA, U.S.A.

**CORE PAPER - XI**
**MICRO BIOLOGY**
**(120 Hours)**

**SUBJECT CODE:**

**Unit - I**

The scope of microbiology - History of microbiology – Classification of microorganisms - Whittaker.

**Unit - II**

Microorganisms – Bacteria – Ultrastructure, flagellation, nutrition, cell division and reproduction. Plant and animal Viruses –features, types. Bacteriophages- multiplication.

**Unit – III**

Microbiology of air- indoor, outdoor. Control of microbes in air by UV, Chemical agents, Filtration, Laminar air flow chamber. Microbiology of water – Bacteriological evidence of pollution, purification of water – sedimentation, filtration, disinfection, sewage treatment.

**Unit – IV**

Microbiology of soil – soil profile, rhizosphere, rhizoplane – plant – microbes interaction 1.Rhizobium 2. Mycorrhiza.

Microbiology of food – milk - composition of milk, dairy products –cheese and yogurt.

Source and processing of the following fermented foods: saurkraut and kimchi, tempeh kedelai, soysauce, toddy and sago – manihot .

**Unit –V**

Microorganisms and industry.

Industrial uses of bacteria – Lactic acid production, vinegar production.

Industrial uses of yeasts - Alcohol fermentation

Industrial uses of molds – Penicillin production

**REFERENCES**


1. Adams M.R., Mass, M.O, (1995), *Food microbiology,*. The Royal Society of Chemistry. Cambridge.
2. Frazier W.C,Westhoff D.C,(2007),. *Food Microbiology,*TMH Publishing Company Ltd. New Delhi.
3. Dubey R.C.,Maheshwari, O.K, (2011),*Practical Microbiology,*S.Chand&Co.Ltd., New Delhi.
4. Michael J. Pelczar, JR. E.C.S Chan, Noel R. Krieg, (2004), *Microbiology,* TMH Publishing Co. Ltd New Delhi.
5. Dubey,R.C, Maheshwari,D.K, (2012), *A Textbook of Microbiology*,S.Chand& Company Ltd. New Delhi

**CORE PAPER - XII**
**BIO TECHNOLOGY**
**(120 Hours)**

**SUBJECT CODE:**

**UNIT-I**

Plant Tissue Culture: Media preparation, Types of tissue culture and its applications- ovule, anther, pollen, embryo culture; uses in agriculture

**UNIT II**

Protoplast culture: Isolation, purification, protoplast fusion; somatic hybrid, somaclonal embryos; synthetic seeds

**UNIT III**

Hybridoma technology: Definition, Antibody, Antigen, Hybridoma, Monoclonal and Polyclonal antibody; Production of monoclonal antibody-Immunization, splenectomy, Cell fusion, selection of clones, cloning and production of antibody

**UNIT IV**

Fermentation: Principle, basic design and working mechanism of a simple fermentor (bioreactor); microbial products-primary and secondary metabolites, enzymes; downstream processing-definition, separation of biomass, cell disruption, concentration of broth, initial purification of metabolites, metabolite-specific purification, de-watering, polishing of metabolites

**UNIT V**

Biofertilisers, Biopesticies and Biofuel: Biofertiliser in agroecosystem-Azolla-anabaena, Azospirillum, Rhizobia-legume, Mycorrhizal fungi. Biopesticides-bacterial, fungal and plant pesticides. Biofuel-Introduction, Biogas production, hydrogen as energy source, hydrocarbon production. Biodiesel- exploring energy from plant resources- algae and Jatropha

**REFERENCES**


1. Dubey, R.C., (1993), *A Text book of Biotechnology*- S.Chand Publishers
2. Ignacimuthu (1998), *Biotechnology,* Tata McGraw Hill Publishers.
3. R Palanisamy(1997), *Research Methodology* Paramount Publishers
4. Ramawat,ShailyGoyal (2000), *Comprehensive Biotechnology,*S.Chand Publishers.

**CORE PAPER - XIII**
**BIO TECHNIQUES**
**(120 Hours)**

**SUBJECT CODE:**

**UNIT I**

Laboratory requirements: General laboratory requirements, types of solutions and buffers, safety aspects in laboratory, Quality control in laboratory-chemicals, glassware, water, solvents

**UNIT II**

Microscopy – Working principles of Dissection, Compound, Phase contrast, Dark-field, Transmission Electron and Scanning Electron Microscope

**UNIT III**

Chromatography- Principles, types and applications- Paper, Thin Layer and Column Chromatography; Centrifugations-Principles, types and applications of Hand, Ultra and Differential centrifugation

**UNIT IV**

Colorimeter-Principles, types and applications. Spectrophotometer-Principles, types and applications.

**UNIT V**

DNA extraction. Electrophoresis-Principles, types and applications- Agarose, SDS-PAGE and Native Gel

**REFERENCES**


1. Skoog, D.S, (1980), *Principles of Instrumental analysis*. HL. Saunders
2. Jayaraman J (1980),*Laboratory Manual of Biochemistry* 1980. Wiley Eastern
3. William BL,Wilson (1980), *Principles and techniques of practical biochemistry* Edward Arnold.
4. Wilson and Walker,(2000),*Practical biochemistry*, 9th Edition, Cambridge Press.
5. Plumer D.T., (1987), *An introduction to Practical Biochemistry*, McGraw Hill

**CORE PRACTICAL - III**
**(120 Hours)**

**SUBJECT CODE:**

**CELL BIOLOGY AND MOLECULAR BIOLOGY**

1. Study of ultra structure of cell organelles
2. Study of Mitosis stages in Onion root tip
3. Study of Meiosis in Flower bud

**REFERENCES**


1. Geraald Karp Cell biology
2. Rrastoel, S.C.1996- Cell and Molecular Biology- New age international publishers.
3. Verma, P.S. and Agarwal, V.K.1995- Cell Biology, Genetics, Molecular Biology & evolution.
4. De Robertis, E.D.P. and De Robertis, E.M.F.Jr. 1987 cell and Molecular Biology Lea Febiger.
5. Old and Primrose 2000 Principles of Gene manupulations


**PHYSIOLOGY AND BIOCHEMISTRY**

Experiments to be performed by the students individually:

1. Determination of solute potential by gravimetric method.
2. Effect of temperature and chemicals on membrane permeability
3. Comparison of relative rate of transpiration in xerophytes and mesophytes.
4. Separation of plant pigments by paper chromatography.
5. Study of rate of photosynthesis under different light intensities.
6. Study of rate of photosynthesis under varying concentration of carbon dioxide
7. Comparison of rate of respiration in germinating seeds and flower buds using respiroscope.
8. Determination of water absorption and transpiration by weighing method.
9. Comparison of rate of stomatal and cuticular transpiration by four leaves method.

**DEMONSTRATION EXPERIMENTS**

1. Test for starch
2. Activity of catalase.
3. Test for carbohydrates.
4. Test for proteins.

**REFERENCES**


1. Tiaz L. and Zeiger.E.2011.Plant Physiology(3rd edition) Benjamin/ Cummings Publishing Company Inc.
2. Jain VK 2010. Fundamentals of plant physiology. S Chand & Company Ltd.
3. Verma SK and MohitVerma. 2007. A text book of plant physiology, biochemistry and biotechnology. S Chand & Company Ltd.
4. Srivastava. H. S. 2010.Plant Physiology, Biochemistry and Biotechnology. Rastogi publications.
5. Salisbury FB & Ross C.W 1991. Plant Physiology. CBS publishers and distributors


**GENETICS, PLANT BREEDING, EVOLUTION**

1. Monohybrid and Dihybrid crosses
2. Test and back crosses
3. Complementation, supplementary and epistasis
4. Linkage and crossing over
5. Gene mapping

**REFERENCES**


1. Babcock, E.B., (2009),*Genetics & plant breeding*, Agrobios India.

2. Gardner EJ, Simmons MJ, Snustad DP (2008),*Principles of Genetics.* 8th Ed. WileyIndia.
3. Snustad, D.P, Simmons, M.J. (2010),*Principles of Genetics,* John Wiley & Sons Inc., India. 5th edition.
4. Pierce B.A, (2011),*Genetics: A Conceptual Approach*, 4th Ed., Macmillan Higher Education Learning
5. Singh, B.D, (2005),*Plant Breeding: Principles and Methods.*Kalyani Publishers. 7th edition.
6. Chaudhari, H.K, (1984),*Elementary Principles of Plant Breeding*. Oxford – IBH. 2nd edition.
7. Acquaah, G, (2007). *Principles of Plant Genetics & Breeding*. Blackwell Publishing.

**PLANT PATHOLOGY**

1. Identification of diseases and pests of common crops
2. Sectioning of the Pathological specimen

**REFERENCES**

1. Rangaswami, G.,Bhagyaraj, D.J, (2004), *Agricultural Microbiology* Prentice Hall of India (P) Ltd., New Delhi.
2. Sharam, P,(1996), *Plant Pathology*.Rastogi Publications, Meerut.
3. Rangaswami., G, Mahadevan, A,(2002), *Diseases of crop plant inIndia,* Prentice Hall of India (P) Ltd. New Delhi.
4. Trigiano, R.N., Windham,M.T.,Windham,A.S, (2003), *Plant Pathology: concepts and laboratory exercises*,CRC PresS
5. Pandey, B.P, (1999),*Plant Pathology,*S.Chand& Co., New Delhi.
6. Chatterjee P.B, (1997), *Plant Protection Techniques*,BharatiBhawan,Patna.
7. Arora J.S, (1990), *Introductory Ornamental Horticulture*, Kalyani Publications
8. Bailey L.H, (1991), *The Standard Cyclopaedia of Horticulture Vol 1,2& 3,* Mcmillan Publications.
9. Bose T.K,Mukerjee D, (1987), *Gardening in India*, Oxford Book House
10. Manibhushan Rao K, (1991), *Text Book of Horticulture*, Macmillan Publications.

**CORE PRACTICAL – IV**
**(120 Hours)**

**SUBJECT CODE:**

**PLANT ECOLOGY AND ENVIRONMENTAL BOTANY**

1) Morphological , anatomical adaptations of Hydrophytes, mesophytes and xerophytes
2) Identification of vegetational zones using maps.
3) Study of Soil Profile, Soil pH.

**REFERENCES**


1. Odum, E.P., (1998), *Fundamentals of Ecology*, Nataraj Publications
2. Agarwal, K.C, (2001),*Environmental Biology,*Nidi Publ. Ltd. Bikaner.
3. BharuchaErach, (1995), *The Biodiversity of India,*Mapin Publishing Pvt. Ltd., Ahmedabad – 4.Kormondy, E.J, (1996). *Concepts of Ecology*. Prentice Hall, U.S.A. 4th edition.
4. Sharma, P.D. (2010), *Ecology and Environment*,Rastogi Publications, Meerut, India. 8th edition.
5. Simpson, M.G. (2006). *Plant Systematics*. Elsevier Academic Press, San Diego, CA, U.S.A.


**MICROBIOLOGY**

1. Preparation of culture media for bacteria , fungi- sterilization procedures.
2. Isolation of rhizosphere, rhizoplane, phylloplane microorganisms.
3. Isolation of pure culture from soil – serial dilution. Gram staining.

**REFERENCES**


1. Adams M.R., Mass, M.O, (1995), *Food microbiology,*. The Royal Society of Chemistry. Cambridge.
2. Frazier W.C,Westhoff D.C,(2007),. *Food Microbiology,*TMH Publishing Company Ltd. New Delhi.
3. Dubey R.C.,Maheshwari, O.K, (2011),*Practical Microbiology,*S.Chand&Co.Ltd., New Delhi.
4. Michael J. Pelczar, JR. E.C.S Chan, Noel R. Krieg, (2004), *Microbiology,* TMH Publishing Co. Ltd New Delhi.
5. Dubey,R.C, Maheshwari,D.K, (2012), *A Textbook of Microbiology*,S.Chand& Company Ltd. New Delhi.


**BIOTECHNOLOGY**

1. Demonstration of Tissue culture (Visit to Tissue culture lab).

**REFERENCES**


1. Dubey, R.C., (1993), *A Text book of Biotechnology*- S.Chand Publishers
2. Ignacimuthu (1998), *Biotechnology,* Tata McGraw Hill Publishers.
3. R Palanisamy(1997), *Research Methodology* Paramount Publishers
4. Ramawat,ShailyGoyal (2000), *Comprehensive Biotechnology,*S.Chand Publishers


**BIOTECHNIQUES**

1. Separation of Pigments using Paper and Thin Layer Chromatography
2. Demonstration of Instruments like Centrifuge, Colorimeter, Spectrophotometer, Electrophoresis.

**REFERENCES**


1. Skoog, D.S, (1980), *Principles of Instrumental analysis*. HL. Saunders
2. Jayaraman J (1980),*Laboratory Manual of Biochemistry* 1980. Wiley Eastern

3. William BL,Wilson (1980), *Principles and techniques of practical biochemistry* Edward Arnold.
4. Wilson and Walker,(2000),*Practical biochemistry*, 9th Edition, Cambridge Press
5. Plumer D.T., (1987), *An introduction to Practical Biochemistry*, McGraw Hill

## ZOOLOGY

## CORE PAPER V
## DEVELOPMENTAL BIOLOGY
## (120 Hours)

**SUBJECT CODE:**

**UNIT I**

Theories of preformation, epigenesis and germplasm, germ layers and derivatives. Spermatogenesis and Oogenesis

**UNIT II**

Fertilization Mechanism and Physiology. Parthenogenesis - Definition & types Cleavage - Types. Different types of blastulae. Gastrulation: General principles

**UNIT III**

Development of Frog: Fertilization, Cleavage, Blastulation, Morphogenetic movement and formation of germ layers, neurulation & notochord formation, mesoderm and coelom formation, organogenesis of brain and eye, hormonal control of amphibian metamorphosis

**UNIT IV**

Development of chick: Structure of egg, fertilization, cleavage, blastulation, gastrulation and formation of germ layers. Salient features of chick embryo at primitive streak stage, 24 , 33, 48 hour stage

**UNIT V**

Extra-embryonic membranes. Placentation in Mammals. Nuclear Transplantation. Regeneration, Cell Differentiation and Gene action during development

**REFERENCES**


1. Verma P.S., V.K.Agarwal and Tyagi 1995, Chordate Embryology, New Delhi,S. Chand & Co.,
2. Arumugam N. 2010 . A Textbook of Embryology , Nagercoil, Saras Publication
3. Balinsky, B.L. 1981, Introduction to Embryology, Philadelphia Saunders College Publishing
4. Berrili, N.J., 1986, Developmental Biology, Chennai ,Tata McGraw Hill Publishing Co. Ltd.
5. http://www.ebooksread.com/authors-eng/william-erskine-kellicott/a-textbook-of-general-embryology-hci.shtml
6. https://allmedicalstuff.com/download-langmans-embryology-pdf-free/
7. http://www.freebookcentre.net/medical_books_download/Embryology-by-Ken-Muneoka.html.

**CORE PAPER VI**
**EVOLUTION**
**(120 Hours)**

**SUBJECT CODE:**

**UNIT I** Origin of life – Theories – creation – cosmozoic – spontaneous generation – Chemical evolution – Urey Miller experiment. Evidences favouring evolution – Comparative anatomical, vestigial organs, physiological, embryological and Biochemical evidences

**UNIT II** Ideas of evolution before Darwin – Lamarckism and Neo-Lamarckism – Darwinism and Neo-Darwinism – Germplasm theory – Mutation Theory – Modern Synthetic theory

**UNIT III** Geological eras – Fossils and fossilization – Dating of fossils – Extinctions - Living fossils. Adaptations – Variations & its origin – Polymorphism – Transient and stable

**UNIT IV** Isolating mechanisms – different types – species concepts – definition of species – Origin of species – Allopatric and Sympatric speciation. Hardy Weinberg law

**UNIT V** Mimicry & Colouration - Batesian and Mullerian. Convergent, Divergent and Parallel evolution - Co-evolution. Evolution of Man - Biological & Cultural.

**REFERENCES**


1. Simpson, G.C. 1967 The meaning of Evolution. Revised Edition - New Haven, Tale University Press.
2. Colbert, E.H. 1969 , Evolution of vertebrates, New York, Wiley.
3. Mayr, Ernst, 1973 ,Animal species and Evolution, England , The Belknap Press of Harvard University, Cambridge.
4. Dobzansky, T. 1976 , Genetics and the origin of species. New Delhi, Oxford and TBH Publishing Co.
5. http://www.freebookcentre.net/biology-books-download/The-Foundations-of-the-Origin-of-Species.html
6. http://www.freebookcentre.net/biology-books-download/Evolution.html
7. http://www.freebookcentre.net/biology-books-download/Outlines-of-evolutionary-biology.html.

**CORE PAPER VII**
**ANIMAL PHYSIOLOGY**
**(120 Hours)**

**SUBJECT CODE:**

**UNIT I**

Nutrition – Types and food requirements Enzymes - classification and nomenclature- Properties of enzymes. Factors affecting enzyme action.; Metabolism of carbohydrates, proteins and lipids - Glycogenesis, glycogenolysis, glycolysis, Kreb's cycle, Beta oxidation of fatty acids, deamination, transamination and decarboxylation of amino acids

**UNIT II**

Respiration – respiratory organs in animals - Respiratory pigments - Adaptations to high altitude and diving. Transport of oxygen and carbondioxide – Anaerobiosis. Circulation - Types - Composition, Properties and functions of blood - Types of Heart. Human - Cardiac cycle - Cardiac rhythm - origin of heart beat - regulation of heart beat - ECG - Blood pressure

**UNIT III**

Excretion – Excretory organs in animals – Kinds of excretory products – ornithine cycle - mechanisms of urine formation in mammals – hormonal regulation of excretion. Osmo-conformers & osmo-regulators – organs concerned with osmo-ionic regulation (skin, gills and kidneys) – osmo-ionic regulation in aquatic and terrestrial vertebrates. Thermoregulation - acclimation and acclimatization

**UNIT IV**

Nervous tissue - Neuron - structure, types. Nerve Impulse - definition - conduction of impulse - synapse - synaptic transmission of impulses - Neurotransmitters, Autonomic nervous system. Muscle tissue: Mechanism of contraction - Theories of muscle contraction

**UNIT V**

Reproduction- male and female reproductive system in mammals, menstrual cycle Endocrine glands - structure, hormones and their functions in vertebrates - Gastrointestinal hormones. Receptors - Photoreceptor - vertebrate mammalian eye - Structure - Physiology of vision - Phonoreceptors - Mammalian ear - working mechanism

**REFERENCES**


1. Parameswaran, Anantha Krishnan and Anantha Subramaniam, 1975. Outlines of Animal Physiology, Chennai , S. Viswanathan, Printers and Publishers, Pvt. Ltd.
2. General and comparative Animal Physiology , 1966, William Hoar, California , Englewood Cliffs, N.J., Prentice-Hall.
3. https://www.researchgate.net/publication/286456096_DrPBReddy's_TEXT_BOOK_OF_ANIMAL_PHYSIOLOGY
4. http://www.ebooksread.com/authors-eng/wesley-mills/a-text-book-of-animal-physiology-with-introductory-chapters-on-general-biology--lli.shtml
5. http://www.freebookcentre.net/biology-books-download/ANIMAL-PHYSIOLOGY.html

**CORE PAPER VIII**
**BIO CHEMISTRY**

**(120 Hours)**

**SUBJECT CODE:**

**UNIT I**

Aqueous solutions - properties of water, Acids, Bases Concept and their relevance to Biological system, Buffers and electrolytes their functions in biological system, acidity, alkalinity determination

**UNIT II**

Biochemistry of carbohydrates, - structure, classification and biological significance, Protein structure - Primary, Secondary , Tertiary and quaternary , characteristics of proteins , Biological significance

**UNIT III**

Biochemistry of lipid - classification and functions , Vitamins -classification , function, source , deficiency

**UNIT IV**

Enzymes – classification – physico- chemical properties – enzyme kinetics – mechanism of enzyme action , factors affecting enzyme activity

**UNIT V**

Biochemistry of hormones and their mode of action – biochemistry of antibiotics and their mode of action – biochemistry of visual pigments and their mode of action- biochemistry of pheromones and mode of action

**REFERENCES**


1. L.Stryer , 1999 Biochemistry IV edition, New York, Freeman Company
2. Lehninger , 1992 Biochemistry worth publications , New Delhi ,Inc Cbs publication
3. H.S. Srivastava , 2013 , Elements of Biochemistry ,Meerut , Rastogi Publications
4. Veerakumari L, 2004, Biochemistry , Chennai , MJP publications
5. G.P.Talwar & L.M. Srivastava 2003 Text book of Biochemistry and Human biology , New delhi Eastern economy, Printice Hall of India
6. http://www.freebookcentre.net/chemistry-books-download/Principles-of-Biochemistry-Lecture-Notes.html
7. http://www.freebookcentre.net/chemistry-books-download/Biochemistry-Free-and-Easy.html
8. http://www.freebookcentre.net/chemistry-books-download/Fundamentals-of-Biochemistry.html

**CORE PAPER IX**
**ENVIRONMENTAL BIOLOGY**
**(120 Hours)**

**SUBJECT CODE:**

**UNIT I**

Introduction to Ecology - Abiotic and biotic factor ; Ecosystem concepts – Energy Flow – Ecological Pyramids – Food chain – Food web. Biogeochemical cycles – Oxygen, Carbon, Nitrogen, phosphorous.

**UNIT II**

Habitat ecology: Terrestrial, Freshwater, Marine, Mangroove ecosystem; Population Ecology- properties and population interactions: Intraspecific and interspecific

**UNIT III**

Pollution: Pollutants - Degradable & Non-degradable ;Causes, effect and control of air, water, land, noise, thermal and radioactive pollution ; Green house effect, Global warming, Acid rain.

**UNIT IV**

Wild life management and laws – sanctuaries and national parks; Natural resources: renewable and nonrenewable resources; Biodiversity: Hot spots of biodiversity- Threats to biodiversity - Conservation of biodiversity - in situ and ex situ conservations

**UNIT V**

Environmental Issues: Environmental degradation – Deforestation – Urbanization – Environmental hazards – Principles of Environmental Impact Assessment.

**REFERENCES**


1. Rastogi V.B. and M.S. Jayaraj, 1988-89. Animal Ecology and distribution of animals, Meerut , Kedar Nath Ram Nath
2. Eugene P. Odum, 1971. Fundamentals of Ecology. Saunders International Student Edition, Philadelphia , W.B. Saunders Company
3. Verma, P.S. and V.K. Agarwal, 1986. Environmental Biology, Chennai ,S. Chand & Co. Ltd.
4. http://www.freebookcentre.net/chemistry-books-download/Interactive-Concepts-in-Biochemistry.html
5. http://www.freebookcentre.net/chemistry-books-download/Biochemistry-And-Molecular-Biology.html.
6. http://www.freebookcentre.net/chemistry-books-download/Fundamentals-of-Biochemistry.html

**CORE PAPER X**
**BIO STATSTICS**
**(120 Hours)**

**SUBJECT CODE:**

**UNIT I**

Biostatistics - Definition and Scope – Collection of data – Census and sampling methods, variable : Discrete and continuous , Concept of statistical population and sample , characteristics of frequency distribution

**UNIT II**

Presentation of Data : Classification and tabulation – Types of classification , Diagrammatical and Graphical representation of statistical data – types : Bar , Pie , Histogram, Line graph

**UNIT III**

Measures of central tendency : Mean , median , mode and weighted arithmetic mean, Harmonic mean, Geometric mean

**UNIT IV**

Measures of dispersion: range, Quartile deviation, mean deviation and standard deviation , correlation and regression

**UNIT V**

Sampling and test of significance of small sample - Student's T Test, F test , $X^2$

**REFERENCES**


1. Elementary statistical methods 2007 , S.P.Gupta, London, Majestic books
2. Jerold H. Zar 1984 , Biostatistics ($2^{nd}$ edition ) Printice Hall of International edition
3. Gurumani N.2004 Introduction to Biostatistics , delhi, MJP Publishers.
4. Sokal RJ and Rohlf SJ 1981 Introduction to Biostatistics London , W.H.Freeman .
5. http://www.mv.helsinki.fi/home/jmisotal/BoS.pdf
6. http://ugymoen.info/ytinu.pdf
7. https://www.amazon.in/Introduction-Biostatistics-Gurumani-N-ebook/dp/B00U9I5YBS

**CORE PAPER XI**
**IMMUNOLOGY**
**(120 Hours)**

**SUBJECT CODE:**

**Unit I.**

Overview of Immune system . Components of immune system: Innate, Adaptive (cell mediated and humoral) - Passive: Artificial and Natural Immunity, Active : Artificial and Natural Immunity.

**Unit II**

Cells and Organs of the Immune System :Haematopoesis , Cells of the immune system, Organs of the Immune system: Primary and Secondary lymphoid organs: structure and their role.

**Unit III**

Antigens , Antigenicity and immunogenicity, Immunogens, Adjuvants and Haptens, Factors influencing immunogenicity, Immunoglobulins :Structure, classes and function, Antigenic determinants on immunoglobulins, Antigen-antibody interactions, , Monoclonal antibodies, Hybridoma technology.

**Unit IV.**

Major Histocompatibility Complex : MHC and immune responsiveness; Cytokines: properties and functions, ; Complement system: components, activation and functions.

**Unit V**

Hypersensitivity – classification ; Vaccines: Types ; Immunodeficiency diseases and Autoimmune diseases

**REFERENCES**


1. Kindt T.J. Goldsby , R.A. Osborne, B. A., Kuby , J(2006) Vi edition. Immunology W.H. Freeman and Company
2. Roitt , 2017 , Essential Immunology ,New jersey, Blackwell publishing.
3. http://www.freebookcentre.net/medical_books_download/Immune-System-and-Immunology-(PDF-63P).html
4. http://www.ebook777.com/kuby-immunology-7th-edition/
5. https://archive.org/details/FundamentalImmunology7thEdition2013PDF_201511

**CORE PAPER XII**
**BIO TECHNOLOGY**
**(120 Hours)**

**SUBJECT CODE:**

**UNIT I**

Biotechnology – Definition , scope, ethics and regulations of Biotechnology; Tools of Genetic Engineering –Enzymes- nuclease, ligase, alkaline phosphatase, restriction endonuclsae , polymerase ; Vectors – Plasmids, Phage vector , insertion vector, Replacement vector,Cosmids and Transposans ,linkers , adapters

**UNIT II**

Techniques of Genetic Engineering – Isolation of DNA, isolation of plasmid, r plasmid formation, transformation of rDNA into host cells, direct gene transfer methods,; identification and selection of recombinants: markers, immunochemical methods, nucleic acid hybridization methods- blotting techniques, PCR technique, DNA finger printing , RAPD, RFLP, Microarray

**UNIT III**

Transgenic animals – GEO, bio safety and regulations- TRIPS, GATT, IPR, patent, copy right, trade mark

**UNIT IV**

Principles and techniques of animal cell culture – sterilization, media preparation, primary culture, cell line culture, applications

**UNIT V**

Applications of genetic Engineering: Industry - Production of single cell protein (SCP) , Alcoholic Fermentation, Fermenter design and types - Biogas production ; Medicine Monoclonal Antibodies , Insulin and Vaccine production ; Agriculture - $N_2$ fixation-agro bacterium; Bio-fertilizers and Bio-Insecticide , Environment– waste and sewage managements.

**REFERENCES**


1. S.S.Purohit & S.K Mathur. 2002 , Biotechnology Fundamentals and applications
2. A. Brown., Higgins I.J., Best G.J., and Jones J. 1996, Gene cloning and Introduction to Biotechnology – Principles and applications, Oxford London, ,Blackwell Scientific Publications,
3. Brown.C.H., Campbell I and Priost.F.G (1987) Introduction of Biotechnology,Oxford Blackwell Scientific Publications.
4. 4 R.C.Dubey , 2014 A Text Book of Biotechnology , New Delhi ,S.Chand & Co.
5. http://www.freebookcentre.net/biology-books-download/Biotechnology-Fundamentals.html
6. http://www.freebookcentre.net/biology-books-download/Biotechnology-Recombinant-DNA-Technology-(PDF-82P).html
7. http://www.freebookcentre.net/biology-books-download/BIOTECHNOLOGY-PRINCIPLES-and-PROCESSES-(PDF-19P).html

**CORE PRACTICAL III**
**(120 Hours)**

**SUBJECT CODE:**

## DEVELOPMENTAL BIOLOGY

Study of the following prepared slides, museum specimens and materials.

1. Sections of mammalian testis and ovary showing the maturation stages of gametes.
2. Slides of mammalian Sperm and Ovum.
3. Study of Egg types – Frog's egg, Hen's egg.
4. Slides of cleavage stages, blastula, gastrula and neurula of frog.
5. Slides of different stages of chick embryo. 18 Hours (primitive streak stage), 24 Hours, 48 Hours, 72 hours and 96 Hours.
6. Placenta of sheep, Pig and Man.

## REFERENCES


1. Verma P.S., V.K.Agarwal and Tyagi 1995, Chordate Embryology, New Delhi,S. Chand & Co.,
2. Arumugam N. 2010 . A Textbook of Embryology , Nagercoil, Saras Publication
3. Balinsky, B.L. 1981, Introduction to Embryology, Philadelphia Saunders College Publishing
4. Berrili, N.J., 1986, Developmental Biology, Chennai ,Tata McGraw Hill Publishing Co. Ltd.
5. http://www.ebooksread.com/authors-eng/william-erskine-kellicott/a-textbook-of-general-embryology-hci.shtml
6. https://allmedicalstuff.com/download-langmans-embryology-pdf-free/
7. http://www.freebookcentre.net/medical_books_download/Embryology-by-Ken-Muneoka.html


## EVOLUTION

1. Fossils : Ammonite , Trilobite , Archaeopteryx
2. Study of evolution of man with the help of Model/chart.

## REFERENCES


1. Simpson, G.C. 1967 The meaning of Evolution. Revised Edition - New Haven, Tale University Press.
2. Colbert, E.H. 1969 , Evolution of vertebrates, New York, Wiley.
3. Mayr, Ernst, 1973 ,Animal species and Evolution, England , The Belknap Press of Harvard University, Cambridge.
4. Dobzansky, T. 1976 , Genetics and the origin of species. New Delhi, Oxford and TBH Publishing Co.
5. http://www.freebookcentre.net/biology-books-download/The-Foundations-of-the-Origin-of-Species.html
6. http://www.freebookcentre.net/biology-books-download/Evolution.html
7. http://www.freebookcentre.net/biology-books-download/Outlines-of-evolutionary-biology.html


## ANIMAL PHYSIOLOGY

1. Influence of body weight on oxygen consumption of fish

2. Influence of temperature on oxygen consumption of fish
3. Determination of oxygen uptake by a terrestrial animal.
4. Qualitative tests for ammonia, urea and uric acids
5. Determination of bleeding time
6. Determination of clotting time
7. Measurement of arterial blood pressure in man using sphygmomanometer
8. Determination of amylase activity with starch

**REFERENCES**


1. Parameswaran, Anantha Krishnan and Anantha Subramaniam, 1975. Outlines of Animal Physiology, Chennai , S. Viswanathan, Printers and Publishers, Pvt. Ltd.
2. *General and comparative Animal Physiology*, 1966, William Hoar, California , Englewood Cliffs, N.J., Prentice-Hall
3. https://www.researchgate.net/publication/286456096_DrPBReddy's_TEXT_BOOK_OF_ANIMAL_PHYSIOLOGY
4. http://www.ebooksread.com/authors-eng/wesley-mills/a-text-book-of-animal-physiology-with-introductory-chapters-on-general-biology--lli.shtml
5. http://www.freebookcentre.net/biology-books-download/ANIMAL-PHYSIOLOGY.html


**BIOCHEMISTRY**

1. Qualitative identification of carbohydrate, protein and lipoid.
2. Analysis of urine for identification of sugar, albumin, ketone bodies

**REFERENCES**


1. L.Stryer , 1999 Biochemistry IV edition, New York, Freeman Company
2. Lehninger , 1992 Biochemistry worth publications , New Delhi ,Inc Cbs publication
3. H.S. Srivastava , 2013 , Elements of Biochemistry ,Meerut , Rastogi Publications
4. Veerakumari L, 2004, Biochemistry , Chennai , MJP publications
5. G.P.Talwar & L.M. Srivastava 2003 Text book of Biochemistry and Human biology , New delhi Eastern economy, Printice Hall of India
6. http://www.freebookcentre.net/chemistry-books-download/Principles-of-Biochemistry-Lecture-Notes.html
7. http://www.freebookcentre.net/chemistry-books-download/Biochemistry-Free-and-Easy.html
8. http://www.freebookcentre.net/chemistry-books-download/Fundamentals-of-Biochemistry.html

**CORE PRACTICAL IV**
**(120 Hours)**

**SUBJECT CODE:**

**ENVIRONMENTAL BIOLOGY**

1. Estimation of Dissolved oxygen, salinity, pH, free CO2 in water samples.
2. Use of Rain gauge, Maximum & minimum thermometer, Hygrometer, photometer
3. Plankton study – Fresh water and marine water zooplankton.
4. Study of Adaptations of aquatic and terrestrial animals , rocky, sandy, muddy shore animals, flying and burrowing animals with museum specimens
5. Study of wild animals with the help of stuffed preparations/ models/ charts/ photographs.
6. Study of natural ecosystem and field report of the visit.

**REFERENCES**


1. Rastogi V.B. and M.S. Jayaraj, 1988-89. Animal Ecology and distribution of animals, Meerut , Kedar Nath Ram Nath
2. Eugene P. Odum, 1971. Fundamentals of Ecology. Saunders International Student Edition, Philadelphia , W.B. Saunders Company
3. Verma, P.S. and V.K. Agarwal, 1986. Environmental Biology, Chennai ,S. Chand & Co. Ltd.
4. http://www.freebookcentre.net/chemistry-books-download/Interactive-Concepts-in-Biochemistry.html
5. http://www.freebookcentre.net/chemistry-books-download/Biochemistry-And-Molecular-Biology.html
6. http://www.freebookcentre.net/chemistry-books-download/Fundamentals-of-Biochemistry.html


**BIO STATISTICS**

1. Calculation regarding mean, median, mode ,SD and SE from given plant/animal specimens.
2. Preparation of histogram and pie diagram with the help of plant/animal specimens provided.

**REFERENCES**


1. Elementary statistical methods 2007 , S.P.Gupta, London, Majestic books
2. Jerold H. Zar 1984 , Biostatistics (2nd edition ) Printice Hall of International edition
3. Gurumani N.2004 Introduction to Biostatistics , delhi, MJP Publishers.
4. Sokal RJ and Rohlf SJ 1981 Introduction to Biostatistics London , W.H.Freeman .
5. http://www.mv.helsinki.fi/home/jmisotal/BoS.pdf
6. http://ugymoen.info/ytinu.pdf
7. https://www.amazon.in/Introduction-Biostatistics-Gurumani-N-ebook/dp/B00U9I5YBS


**IMMUNOLOGY**

1. Study of T.S. of primary and secondary Lymphoid organs using prepared slides
2. Study of ABO blood group
3. Spotters- Principle and application of immunoelectrophoresis ( using animated videos/ kits )
4. Spotters - Principle and application of antigen –antibody reactions – agglutination , precipitation; Immunodiffusion , ELIZA, RIA ( using animated videos/ kits )

**REFERENCES**


1. Kindt T.J. Goldsby , R.A. Osborne, B. A., Kuby , J(2006) Vi edition. Immunology W.H. Freeman and Company
2. Roitt , 2017 , Essential Immunology ,New jersey, Blackwell publishing.
3. http://www.freebookcentre.net/medical_books_download/Immune-System-and-Immunology-(PDF-63P).html
4. http://www.ebook777.com/kuby-immunology-7th-edition/
5. https://archive.org/details/FundamentalImmunology7thEdition2013PDF_201511


**BIOTECHNOLOGY**

1. Identification of vectors ( diagrams/ slides )
2. Spotters - Autoclave , Refrigerated centrifuge , Micropipette, Electrophoretic apparatus Trans illuminator ,PCR, Laminar flow hood , CO2 incubator

**REFERENCES**


1. S.S.Purohit & S.K Mathur. 2002 , Biotechnology Fundamentals and applications
2. A. Brown., Higgins I.J., Best G.J., and Jones J. 1996, Gene cloning and Introduction to Biotechnology – Principles and applications, Oxford London, ,Blackwell Scientific Publications,
3. Brown.C.H., Campbell I and Priost.F.G (1987) Introduction of Biotechnology,Oxford Blackwell Scientific Publications.
4. R.C.Dubey , 2014 A Text Book of Biotechnology , New Delhi ,S.Chand & Co.
5. http://www.freebookcentre.net/biology-books-download/Biotechnology-Fundamentals.html
6. http://www.freebookcentre.net/biology-books-download/Biotechnology-Recombinant-DNA-Technology-(PDF-82P).html
7. http://www.freebookcentre.net/biology-books-download/BIOTECHNOLOGY-PRINCIPLES-and-PROCESSES-(PDF-19P).html.

**EDUCATION**
**LEARNING AND TEACHING**
**(60 Hours)**

**SUBJECT CODE**

**Course objectives:**

At the end of the course, the student-teachers will be able to:

1. develop an understanding of the nature of learning and teaching.
2. develop an understanding of the behavioural theories, cognitive and humanistic theory.
3. critically evaluate the theory of constructivism.
4. understanding the teaching diverse classroom.
5. identify the need and importance of teacher student relationship
6. discuss the importance of teaching as a profession.

**Unit I Nature of learning**

Learning: meaning and definition - elements of learning – basic principles of learning and their implications – rote learning vs. meaningful learning – principles and techniques of active learning and their implications – self learning.

(***Suggested Instructional approaches/ methods:***

i) Student seminar on principles of active learning.

ii) Invited talk by experts based on the nature of learning.)

**Unit II Nature of Teaching**

Teaching: Definition and meaning – Characteristics of good teaching – Views of great thinkers and philosophers on teaching - Becoming a reflective teacher and his characteristics - My goals as a teacher.

***(Suggested Instructional approaches/ methods:***

i) Group discussion on characteristic of a good teacher.

ii) Student seminar on becoming a reflective teacher.)

**Unit III Behavioral Theories of Learning**

Learning – meaning of learning as defined by behaviourists – classical conditioning (Pavlov) – Law of effect (Thorndike) – operant conditioning and shaping (Skinner) – social learning (Bandura) - Basic assumptions of behavioural theory – strengths and limitations.

(***Suggested Instructional approaches/ methods:***

i) Invited talk by the experts on the behavioural theories of learning.

ii)Student seminar on basic assumptions of behavioural theory.)

**Unit IV Cognitive and humanistic theories of learning**

Learning – meaning of learning as defined by cognitive psychologists – Insight learning (Kohlberg) - Modes of cognitive development (Bruner) – Stages of intellectual

development (Piaget) – Learning styles (Kolb) – Self-actualization ( Maslow) - Theory of a fully functioning person ( Carl Rogers).

***(Suggested Instructional approaches/ methods:***

i) Student seminar on the cognitive theories of learning.

ii) Invited talk by experts on the humanistic theory of learning.)

**Unit V Theory of Constructivism**

Constructivism – meaning and definitions - The nature of constructivist learners the role of teachers, the nature of learning process, collaboration among learners and pedagogical approaches to constructivism - Gagne's eight levels of learning.

***(Suggested Instructional approaches/ methods:***

i) Presentation of a report based on the group discussion on constructivism.

ii) Group discussion on Gagne's eight levels of learning.)

**Unit VI Learner- centered teaching**

Meaning - characteristics of learner-centered teaching/learner-centered learning. Need for learner-centered approaches in teaching advantages of learner-centered teaching vs teacher-centered learning, teaching – Learner - centered techniques of teaching and their advantages.

**(*Suggested Instructional approaches/ methods:***

i) Student seminar on learner - centered teaching.

ii) A debate on leaner-centered teaching vs teacher-centered learning.)

**Unit VII Teaching in Diverse classrooms**

Meaning and definitions of diverse classroom-Teaching in a diverse classroom-preparations of teachers of diverse classroom-Techniques of teaching in a diverse classroom/Diverse teaching strategies for diverse learners-effective teaching in a diverse class room-Diversity in the classroom.

**(*Suggested Instructional approaches/ methods:***

i) Talk by the expert on preparation of teachers for diverse classroom.

ii) Student seminar on effective teaching in a diverse classroom.)

**Unit VIII Learning in and out of School**

Purpose of learning in and out of school: what we know? and what we need to know? Importance of observation learning out of school- out of school learning: extending curriculum learning to the local area -approaches to learning outside the class room- learning for outside the classroom-advantages of learning outside the classroom.

**(*Suggested Instructional approaches/ methods:***

i) Teacher talk on importance of observation learning.

ii) Discussion on approaches to learning outside the school.)

**Unit IX Teacher- Student Relationship**

Meaning - Need for maintaining teacher-student relationship - inter-personal approach in classroom management - strategies for improving student engagement in learning - Healthy classroom management and academic achievement.

**(*Suggested Instructional approaches/ methods:***

i) Invited talk by experts on the effective teacher student relationship.

ii) Seminar on healthy classroom management and academic achievement.

**Unit X Teaching as a profession**

Nature of teaching - Teaching as a profession - characteristics of effective and ineffective teaching - why teaching is the most important profession -Attitude of student-teachers towards teaching profession - Qualities of a professional teacher - Faculty development programmes - Teaching and Learning for sustainable future.

**(*Suggested Instructional approaches/ methods:***

i) Teacher talk on qualities of a good teacher.

ii) Student seminar on "teaching as the noblest profession".)

**Tasks and Assignments:**

1. Prepare a report based on the interaction/interview with expert(s) for the theories of learning and teaching, teaching as a profession.

2. Prepare records that capture a variety of images of learning and teaching.

**REFERENCES**


1. Bandura, A., & Walters, R. H. (1963). *Social learning and personality development*. New York: Holt, Rinehart, & Winston.
2. Bruner, J.S. (1971). The process of education revisited. Phi Delta Kappan, 53, 18–21.
3. Gropper, G.L. (1987). A lesson based on a behavioral approach to instructional design. In C.M. Reigeluth (Ed.), Instructional theories in action (pp. 45–112).
4. Jayaraman, Chindhai.(2005). *School days: In Children's Perspective*. Chennai: Vinodh publications.
5. Thangasamy,Kokila. (2016). *Teach Gently*. Chennai : Pavai Pathippagam.
6. Thorndike, E. L. (1905). *The elements of psychology*. New York: A. G. Seiler.
7. Vygotsky's (2004) philosophy: Constructivism and its criticisms examined Liu & Matthews,*International Education Journal*, 2005, 6(3), 386-399.
8. http://www.businessdictionary.com/definition/conservatism.html
9. https://www.oecd.org/edu/ceri/50300814.pdf
10. http://www.psychologydiscussion.net/learning/learning-meaning-nature-types-and-theories-of-learning/652

**PEDAGOGY OF A SCHOOL SUBJECT PART – I (METHODOLOGY)**
**1. PEDAGOGY OF MATHEMATICS**
**(Part - I Methodology)**

**(60 Hours)**

**SUBJECT CODE:**

**Course objectives:**
At the end of the course, the student- teachers will be able to:

1. understand the aims and objectives of teaching Mathematics.
2. formulate instructional objectives for a lesson.
3. gain mastery of the teaching skills .
4. apply various methods in teaching of Mathematics.
5. use various resources in teaching Mathematics.

**Unit I Aims and objectives of teaching Mathematics**

Mathematics: Meaning, nature and scope - Aims and objectives of teaching Mathematics in schools – Need and significance of teaching Mathematics - Values of teaching Mathematics.

(***Suggested instructional approaches/methods:***

i) Teacher talk/ Invited lecture on the place of Mathematics in school curriculum.

ii) Student seminar on the need, significance and values of teaching Mathematics.)

**Unit II Planning for Instruction**

Steps in planning a lesson: Setting lesson goals - Designing a unit plan - Designing a lesson plan - Bloom's Taxonomy of educational objectives - Formulating Instructional objectives at cognitive, affective and psychomotor levels - Structure of a four-fold lesson plan - Preparation of a model lesson plan - Types of test-items - Constructing test-items for formative evaluation in class.

**(*Suggested instructional approaches/methods*:**

i) Write instructional objectives for a lesson in Mathematics for Level I & II.

ii) Prepare a model lesson plan for Level I & II in Mathematics.)

**Unit III Practising the Teaching Skills in Mathematics**

Meaning of teaching – Understanding major teaching skills: Introducing – explaining – questioning - varying the stimulus - non-verbal cues – reinforcement - closure and fluency in communication - Practising a mini-lesson with multiple-teaching skills (for 20 minutes): Observation and feedback on the practice of integration of teaching skills – Understanding major steps in teaching a mini-lesson: Motivation –presentation – interaction - reflection and summing up - Practising a mini-lesson (for 20 minutes): Observation and feedback on mini-teaching.

***(Note: Teacher-Educators should give a demonstration of a mini-lesson by integrating major teaching skills (for 20 minutes) and they should demonstrate a mini-lesson by integrating major teaching steps in teaching.)***

**(*Suggested instructional approaches/methods*:**

i) Prepare a report on the practising of a mini-lesson with multiple-teaching skills by observing peers.

ii) Prepare two mini-lessons and practise them in front of peers in the class for Level I and Level II.)

**Unit IV Methods of Teaching Mathematics**

**Teacher-centered methods:** Lecture method – Analytical and Synthetic methods - Deductive and Inductive methods - Demonstration method - Team-teaching. **Learner-centered methods**: Project method - Peer tutoring/teaching by students- Individual activities - experiential learning- Teacher-guided learning- Problem-solving method- Small group/whole-class interactive learning: Student seminar - group discussion - Mixed-ability grouping - Maths through games and puzzles. **Recent trends:** Constructivist learning - Problem-based learning - Brain-based learning - Collaborative learning - Flipped learning - Blended learning - e-Learning trends - Video conferencing.

(***Suggested instructional approaches/methods:***

i) Teacher talk/Expert talk on different methods of teaching Mathematics.

ii) Preparation and presentation of a report on different methods of teaching Mathematics.)

**Unit V Resources for Teaching Mathematics**

**Print resources:** Newspapers – Journals – Magazines - Mathematics Encyclopaedias. **Audio resources:** Radio talk - audio tapes - DVDs/CDs. **Visual resources:** Pictures – charts – posters – photographs - flash cards - models. **ICT resources**: Radio – TV –Internet – multimedia - interactive whiteboard. **Community resources:** Fieldtrips - Mathematics exhibition/fair - Mathematics Laboratory/ Mathematics Resource centre - Mathematics club – Qualities of a good Mathematics textbook - Qualities of a Mathematics teacher.

(***Suggested instructional approaches/methods:***

i) Teacher talk/Invited lecture talk on different resources for teaching Mathematics.

ii) Preparation and presentation of a report on different resources for teaching Mathematics.)

**Tasks and Assignments:**

1. Prepare and submit an evaluative report on different methods of teaching Mathematics.
2. Prepare and submit a report on Mathematics Resource Centre.

**REFERENCES**


1. Agarwal, S.M. (2001). *A course in teaching of modern mathematics*. New Delhi: Dhanapat Rai Publishing.

2. Bagyanathan, D. (2007). *Teaching of mathematics. Chennai*: Tamil Nadu Textbook Society.

3. James, Anice. (2010). *Teaching of mathematics.* Hyderabad: Neelkamal Publications.

4. Sidhu, Kulbir Singh. (2010). *Teaching of mathematics*. New Delhi: Sterling Publishers.

5. Mathematics Books for Standard VI – XII. Tamil Nadu TextBook Corporation, Government of Tamil Nadu.

6. Wadhwa, S. (2008). *Modern methods of teaching mathematics*. New Delhi: Karan.

7. கிருஷ்ணவேணி அருணாசலம்(2004). *கரும்பென இனிக்கும் கணிதம்.* சென்னை: பிரியா பதிப்பகம்.

8. http://tcthankseducation.blogspot.in/2010/04/micro-teaching-and-teaching-skills.html

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**PEDAGOGY OF A SCHOOL SUBJECT PART - I (METHODOLOGY)**
**2. PEDAGOGY OF PHYSICAL SCIENCE**
**(Part - I Methodology)**
**(60 Hours)**

**SUBJECT CODE:**

**Course objectives:**

At the end of the course, the student- teachers will be able to:

1. understand the aims and objectives teaching of physical science.
2. formulate instructional objectives for a lesson.
3. gain mastery of the teaching skills.
4. apply various methods in teaching physical science.
5. use various resources in teaching physical science.

**UNIT I Aims and objectives of teaching Physical Science**

Physical Science: Meaning, nature and scope – Aims and objectives of teaching Physical Science in schools - Need and significance of teaching Physical Science - Values of teaching Physical Science.

***(Suggested instructional approaches/methods:***

i) Teacher talk/Invited talk on the place of Physical Science in the school curriculum.
ii) Student seminar on the need, significance and values of teaching Physical Science.)

**UNIT II Planning for Instruction**

Steps in planning a lesson: Setting lesson goals – Designing a unit plan – Designing a lesson plan – Bloom's Taxonomy of educational objectives: Formulating educational objectives at cognitive, affective and psychomotor levels – Structure of a four-fold lesson plan – Preparation of a model lesson plan – Types of test-items - Constructing test-items for formative evaluation in class.

***(Suggested instructional approaches/methods:***

i) Write the instructional objectives for a lesson in Physical Science at Level I & II.
ii) Prepare a model lesson plan in Physical Science for Level I & II).

**UNIT III Practising the Teaching Skill in Physical Science**

Meaning of teaching – Understanding major teaching skills: Introducing-explaining –questioning - varying the stimulus - non-verbal cues- reinforcement - closure and fluency in communication – Practicing a mini-lesson with multiple-teaching skills (for 20 minutes): Observation and feedback on the practice of integration of teaching skills – Understanding major steps in teaching a mini-lesson: Motivation - presentation-interaction- reflection and summing up – Practicing a mini-lesson (for 20 minutes): Observation and feedback on mini-teaching. ***(Note: Teacher-Educators should give a demonstration of a mini-lesson by integrating major teaching skills (for 20 minutes) and they should demonstrate a mini-lesson by integrating major teaching steps in teaching.)***

**(*Suggested instructional approaches/methods*:**

iii) Prepare a report on the practising of a mini-lesson with multiple-teaching skills by observing peers.

iv) Prepare two mini-lessons and practise them in front of peers in the class for Level I and Level II.)

**UNIT IV Methods of Teaching Physical Science**

***Teacher-centered methods:*** Lecture method - Demonstration method - Team-teaching. ***Learner-centered methods:*** Laboratory method – Project method - Peer tutoring/teaching by students- Project method- Individual activities - experiential method – Teacher-guided learning- Problem-solving method - Small group/whole-class interactive learning: Student seminar- group discussion - Mixed-ability grouping. ***Recent Trends:*** Constructivist learning - Problem-based learning- Brain-based learning- Collaborative learning- Flipped learning - Blended learning - e-Learning trends - Videoconferencing.

***(Suggested instructional approaches/methods:***

i) Teacher talk/ Invited lecture on different methods of teaching Physical Science.

ii) Preparation and presentation of a report on different methods of teaching Physical Science.)

**UNIT V Resources for Teaching Physical Science**

***Print Resources:*** Newspapers - journals and magazines- science encyclopedias. ***Audio Resources:*** Radio talk- audio tapes- DVDs/ CDs. ***Visual Resources:*** Pictures - flash cards- charts- posters - photographs- models. ***ICT Resources:*** Radio – television- Internet- multimedia- Interactive whiteboard. ***Community Resources:*** Science centres

-Science exhibition/ fair - Fieldtrip – Qualities of a good science textbook - Qualities of a Science teacher.

***(Suggested instructional approaches/methods:***

i) Teacher talk/ Invited lecture talk on different resources for teaching Physical Science.

ii) Preparation and presentation of a report on different resources for teaching Physical Science.)

**Tasks and Assignments:**

i) Prepare and submit an evaluative report on different methods of teaching Physical Science.

ii) Prepare and submit a report on Physical Science resource centre.

**REFERENCES**


1. Bawa, M.S. & Nagpal, B.M. (2010). *Developing teaching competencies*. New Delhi: Viva Book House.
2. Bhatia, K.K. (2001). *Foundations of teaching learning process*. Ludhiana: Tandon Publications.
3. Bloom, S. Benjamin, (1984). *Taxonomy of educational objectives:* Book 1 Cognitive domain. New York: Longmans, Green.
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5. Joyce & Weil, (2004). *Models of teaching*. New Delhi: Prentice Hall of India.
6. Passi, B.K. (1991). *Models of teaching*. New Delhi: NCERT.
7. Verma Ramesh, & Sharma, K. Suresh, (1998). *Modern trends in teaching technology*. New Delhi: Anmol Publications.
8. http://teaching.uncc.edu/learning-resources/articles-books/best-practice/instructional-methods/150-teaching-methods
9. http://en.wikipedia.org/science_education
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**PEDAGOGY OF A SCHOOL SUBJECT PART - I (METHODOLOGY)**

**3. PEDAGOGY OF BIOLOGICAL SCIENCE**

**(Part - I Methodology)**

**(60 Hours)**

**SUBJECT CODE:**

**Course objectives:**

At the end of the course, the student- teachers will be able to:

1. understand the aims and objectives teaching of biological science.
2. formulate instructional objectives for a lesson.
3. gain mastery of the teaching skills.
4. apply various methods in teaching biological science.
5. use various resources in teaching biological science.

**UNIT I Aims and objectives of teaching Biological Science**

Biological Science: Meaning, nature and scope –Aims and objectives of teaching Biological Science in schools - Need and significance of teaching Biological Science - Values of teaching Biological Science.

***(Suggested instructional approaches/methods:***

i. Teacher talk/Invited talk on the place of Biological Science in the school curriculum.
ii. Student seminar on the need, significance and values of teaching Biological Science.)

**UNIT II Planning for Instruction**

Steps in planning a lesson: Setting lesson goals – Designing a unit plan – Designing a lesson plan – Bloom's Taxonomy of educational objectives - Formulating educational objectives at cognitive, affective and psychomotor levels – Structure of a four-fold lesson plan – Preparation of a model lesson plan – Types of test-items - Constructing test-items for formative evaluation in class.

***(Suggested instructional approaches/methods:***

i. Write the instructional objectives for a lesson in Biological Science at level I & II.
ii. Prepare a model lesson plan in Biological Science for level I & II.)

**UNIT III Practising the Teaching Skills in Biological Science**

Meaning of teaching – Understanding major teaching skills: Introducing - explaining, questioning - varying the stimulus - non-verbal cues – reinforcement - closure and fluency in communication – Practising a mini-lesson with multiple-teaching skills (for 20 minutes): Observation and feedback on the practice of integration of teaching skills – Understanding major steps in teaching a mini-lesson: Motivation, presentation,

interaction, reflection and summing up –Practising a mini-lesson with five teaching steps (for 20 minutes):Observation and feedback on the integrating of teaching steps in mini-teaching. ***(Note: Teacher- Educators should give a demonstration of a mini-lesson by integrating major teaching skills (for 20 minutes) and they should demonstrate a mini-lesson by integrating major teaching steps in teaching.)***

**(*Suggested instructional approaches/methods*:**

i. Prepare a report on the practising of a mini-lesson with multiple-teaching skills by observing peers.
ii. Prepare two mini-lessons and practise them in front of peers in the class for Level I and Level II.)

**UNIT IV Methods of Teaching Biological Science**

***Teacher-centered methods:*** Lecture method - Demonstration method - Team-teaching. ***Learner-centered methods:*** Laboratory method – Project method - Peer tutoring/teaching by students - Project method - Individual activities - Experiential method – Teacher-guided learning - Problem-solving method - Small group/whole - class interactive learning: Student seminar - Group discussion - Mixed-ability grouping. **Recent Trends:** Constructivist learning - Problem-based learning - Brain-based learning - Collaborative learning - Flipped learning - Blended learning - e-Learning trends - Video conferencing.

***(Suggested instructional approaches/methods:***

i. Teacher talk/ Invited lecture on different methods of teaching Biological Science.
ii. Preparation and presentation of a report on different methods of teaching Biological Science.)

**UNIT V Resources for Teaching Biological Science**

***Print Resources:*** Newspapers - journals and magazines - Science Encyclopedias. ***Audio Resources:*** Radio talk - audio tapes - DVDs/CDs.***Visual resources:*** Pictures - flash cards – charts - posters - photographs - models. ***ICT Resources:*** Radio – television - Internet, multimedia - interactive whiteboard. ***Community resources:*** Zoological gardens, Botanical gardens, eco-park - aquarium - science exhibition/fair - fieldtrip – Qualities of a good biology textbook - Qualities of a Biology teacher.

***(Suggested instructional approaches/methods:***

i. Teacher talk/Expert talk on different resources for teaching Biological Science.

ii. Preparation and presentation of a report on different resources for teaching Biological Science.)

**Tasks and Assignments:**

1. Prepare and submit an evaluative report on different methods of teaching Biological Science.
2. Prepare and submit a report on Biological Science resource centre.

**REFERENCES**


1. Bawa, M.S.& Nagpal, B.M. (2010). *Developing teaching competencies*. New Delhi: Viva Book House.
2. Bhatia, K.K. (2001). *Foundations of teaching learning process*. Ludhiana: Tandon Publications.
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4. Joyce & Weil, (2004). *Models of teaching*. New Delhi: Prentice Hall of India.
5. Miller, David.F.(1938) *Methods and materials for teaching biological sciences.* New York: McGraw Hill Book Company.
6. Passi, B.K. (1991). *Models of teaching*. New Delhi: NCERT.
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**EPC 3 -CRITICAL UNDERSTANDING OF ICT**
**(30 Hours)**

**SUBJECT CODE:**

The aim of this course is to enhance the professional capacities of a student teacher in integrating Information and Communication Technologies (ICTs) with effective teaching and learning in a classroom.

**Course objectives**: To enable the student-teachers:

1. To teach effectively in a "technology enhanced classroom" (previously referred to as "smart classroom".
2. To achieve knowledge-comprehension, practice skills and presentation skills in ICT.

**How to prepare a student teacher for a technology enhanced classroom?**

The teachers in Colleges of Education should train the student- teachers:

1. To operate /use various ICT tools such as computer, laptop/Internet, Interactive whiteboard, Tablet PC, iPad, iPhone, Mobile phones, Digital cameras, Multimedia equipments (audio/video), Skype and video -conferencing.
2. To browse the Internet, using a computer /laptop, identify and use education related websites and video/audio resources in teaching- learning.
3. To prepare teaching material/learning resource materials: e-content, e-booklet for selected school subject areas and to create edu(cational) blogs for individual/ group students for strengthening sharing and learning.
4. To use a laptop /PC for preparing slides for PowerPoint presentations/ lectures and also download the video resources available on the internet and use them embedded with slide presentations.
5. To teach a content /lesson using an Interactive whiteboard (by connecting a desktop computer to a whiteboard and project Google images onto it).
6. To use a visualizer/document camera (visual projector) to display and share an information to the whole class.
7. To use a mobile device/a camera phone to take a series of snapshots of children's actions events/ scenes/ activities and prepare a photo documentary or photo album with explanatory notes/ descriptions.
8. Prepare videos on different teaching styles of experienced teachers/ peers and keep them available for viewing as a stream on a computer.
9. Organize a few video-conferencing classes (organize Skype-based video conferencing) inviting experts in school subjects and encourage the students to share the learning experiences through WhatsApp with their classmates and others.
10. To create educational blogs (Edublogs) for individual/group students for sharing and learning articles/ class notes/ assignments and participating in active blogging community.

**Tasks and Assignments**

1. Write a report based on your preparation of e-content and presentation of it to the class with different ICT tools.
2. Write a report on the organization of video-conferencing with an educational expert.