MATHEMATICS

PAPER – XIV
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.,

PAPER - XV

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.

PAPER - XVI

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.

PAPER - XVII

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.

PAPER - XVIII
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 -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,
5. http://physicsdatabase.com/free-physics books/
6. http://bookboon.com/en/physics-ebooks

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.
4. http://physicsdatabase.com/free-physics books/
5. http://bookboon.com/en/physics-ebooks

CORE PAPER –XI
RELATIVTYAND 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
   http://bookboon.com/en/physics-ebooks

CORE PRACTICAL -III

(60 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

(60 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 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.

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 triphenylmethylfree radical, reactions involving free radicals-polymerization, allylicbromination 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 sulphursystems.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 - 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-enoltautomerism.

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 λ_{max} in conjugated and extended conjugated dienes anddienones. 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,aliphaticaldehydes,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

CORE PRACTICAL – III

(120 Hrs)

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 [HClvsNaOH]

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 - IX
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,andsulphur

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 - X
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 - XI
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 - XII
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

(60 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
(60 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 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
BIOSTATISTICS
(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
BIOTECHNOLOGY
(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.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 VILearner- 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.

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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 - Practisinga 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.

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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 IIIPractising 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.

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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 TeachingBiological 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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