



GOA UNIVERSITY
Sub P.O. Goa University, Taleigao Plateau, Goa- 403206.

B.Sc.B.Ed PROGRAMME

SYLLABUS OF B.Sc.B.Ed. Programme (from the academic year 2015-16)

Mathematics Course

A brief description of the course.

- **Purpose :** To train students for PG study of mathematics and to go for specialisation or career where mathematics is need as one subject.
To make available facility of taking Mathematics with Social science subjects.
- **Prerequisites:** 10 + 2 (Science) level mathematics
- **Credits** (theory, tutorials,) NA
- **Number of semesters, how the courses are distributed:** 6 semesters (2 per year)
(Details given below)
- **Dissertation:** Project work at semester V and VI
- **Field work, etc.** NA

B. Sc. (Mathematics) List of Courses

In the following tables, L refers to lectures, T to tutorials and P to practicals.
Description of a course appears on the page number listed in the tables.

Compulsory Courses

Course Number and Name
First Year B.Sc. Semester I
BSEDMATHS 101: Calculus of one variable
BSEDMATHS 102: Analytical Geometry
First Year B.Sc. Semester II
BSEDMATHS 201: Discrete Mathematics
BSEDMATHS 202: Probability & Statistics
Second Year B.Sc. Semester III
BSEDMATHS 301: Numerical Methods
BSEDMATHS 302: Calculus of Two variables
Second Year B.Sc. Semester IV
BSEDMATHS 401: Matrix Algebra
BSEDMATHS 402: Differential Equations I
Third Year B.Sc. Semester V
BSEDMATHS 501: Analysis I
BSEDMATHS 502: Algebra
BSEDMATHS 503: Analysis II
Third Year B.Sc. Semester VI
BSEDMATHS 601: Linear Algebra
BSEDMATHS 602: Metric Spaces
BSEDMATHS 603: Complex Analysis
Course Number and Name
Fourth Year B.Sc. Semester VII
BSEDMATHS 504: Vector Calculus
BSEDMATHS 505: Number Theory
BSEDMATHS 506: Operations Research I
Fourth Year B.Sc. Semester VIII
BSEDMATHS 604: Analysis III
BSEDMATHS 605: Differential Equations II
BSEDMATHS 606: Operations Research II

Syllabus of the B. Sc. Mathematics Curriculum

[Effective from academic year 2013-14]

First Year B.Sc.

Semester I: BSEDMATHS 101 : Calculus of one variable

BSEDMATHS 102 : Analytical Geometry

Semester II: BSEDMATHS 201: Discrete Mathematics

BSEDMATHS 202 : Probability & Statistics

Second Year B.Sc.

Semester III: BSEDMATHS 301: Numerical Methods

BSEDMATHS 302: Calculus of Two variables

Semester IV: BSEDMATHS 401: Matrix Algebra

Third Year B.Sc.

Semester V: Compulsory Papers

BSEDMATHS 501: Analysis I

BSEDMATHS 502: Algebra

BSEDMATHS 503: Analysis II

Semester VI: Compulsory Papers

BSEDMATHS 601: Linear Algebra

BSEDMATHS 602: Metric Spaces

BSEDMATHS 603: Complex Analysis

Fourth Year B.Sc.

Semester VII: Optional Papers

BSEDMATHS 504: Vector Calculus

BSEDMATHS 505: Number Theory

BSEDMATHS 506: Operations Research I

Semester VIII: Optional Papers

BSEDMATHS 604: Analysis III

BSEDMATHS 605: Differential Equations II

BSEDMATHS 606: Operations Research II

Semester-I

BSEDMATHS 101: CALCULUS OF ONE VARIABLE

1. FUNCTIONS AND GRAPHS.

Prerequisites: Real Numbers, bounded sets. Definitions: Function, domain and range; One-one and onto functions. Examples. Graphical representation of functions.

Polynomial and Rational functions. Power function: $y = x^\alpha$, where α is a real

number ($x > 0$), General exponential function: $y = a^x$, where a is a positive number not equal to unity. Logarithmic function: $y = \log_a x$, where a is a positive number not equal to unity. Trigonometric functions: $\sin x$, $\cos x$, $\tan x$, $\cot x$, $\sec x$ and $\csc x$.

Inverse trigonometric functions: $\arcsin x$, $\arccos x$, $\arctan x$, $\text{arccot } x$, $\text{arcsec } x$ and $\text{arccsc } x$. Absolute value function ($| \cdot |$) Properties of the absolute Value function.

Greatest integer function[].

Definitions of 'sup' and 'inf' of a non-empty subset S of \mathbb{R} . Theorems on 'sup' and 'inf'. Axiom of Lub (sup).

Reference: Chapter 2 in [1] and/or Chapter 1 & 3 in [2]. Also [4]

1. 2. LIMIT AND CONTINUITY.

Limit, left limit and right limit. Theorems:

$$\begin{aligned} & \lim_{x \rightarrow c} (f \pm g)(x) = \lim_{x \rightarrow c} f(x) \pm \lim_{x \rightarrow c} g(x) \\ & \lim_{x \rightarrow c} (fg)(x) = \lim_{x \rightarrow c} f(x) \lim_{x \rightarrow c} g(x) \\ & \lim_{x \rightarrow c} \left(\frac{f}{g} \right)(x) = \frac{\lim_{x \rightarrow c} f(x)}{\lim_{x \rightarrow c} g(x)} \end{aligned}$$

$$= \lim_{x \rightarrow c} f(x) \pm \lim_{x \rightarrow c} g(x).$$

$$(x). \lim_{x \rightarrow c} g(x).$$

$$\text{provided } \lim_{x \rightarrow c} g(x) \neq 0.$$

Limit of a function. Definition of 'lim $f(x)$ as $x \rightarrow \infty$.' Uniqueness of limit of a Function. Continuity at a point, continuity in an interval, types of discontinuities. Theorems on continuity: (a) If a function is continuous on a closed interval, then it attains its bounds at least once in it. (b) If a function f is continuous at an interior point c of an interval and $f(c) \neq 0$ then f keeps the same sign of $f(c)$ in a neighbourhood of c . (c) If a function f is continuous on a closed & bounded interval $[a, b]$, and $f(a)f(b) < 0$, then there exists at least one point $c \in (a, b)$ such that $f(c) = 0$. (d) Intermediate value theorem. (e) fixed point theorem.

Reference: Chapter 5 in [3]. Also Chapter 3 in [4]

1. 3. THE DERIVATIVE

Drivability (Differentiability) at a point, Drivability in an interval, increasing and decreasing functions, Sign of the derivative. Higher order derivatives. Theorems: (a) A function which is derivable at a point is necessarily continuous at that point. (b) If f is derivable at c and $f'(c) \neq 0$, then $1/f$ is also derivable at c . (c) Darboux's theorem. (d) Intermediate value theorem for derivatives. (e) Rolle's theorem. (f) Lagranges mean value theorem. (g) Cauchy's

mean value theorem. (h) Taylor's theorem. (i) Maclaurin's theorem. Increasing and decreasing functions.

Reference: Chapter 6 in [3]. Also Chapter 4 in [4]

4. APPLICATION OF TAYLOR'S THEOREM

Approximations. Extreme Values, Investigation of the points of Maximum and Minimum Values. Indeterminate forms, $0/0$ form, ∞/∞ form, Problems. Theorems:

(a) If $f(c)$ is an extreme value of a function f , then $f'(c)$, in case it exists, is zero. (b) If c is an interior point of the domain of a function f and $f'(c) = 0$, then the function has a maxima or a minima at c according as $f''(c)$ is negative or positive. (c) If f, g be two functions such that (i) $\lim_{x \rightarrow a} f(x) = \lim_{x \rightarrow a} g(x) = 0$ and (ii) $f'(a), g'(a)$ exist and $g'(a) \neq 0$

then $\lim_{x \rightarrow a} \frac{f(x)}{g(x)} = \frac{f'(a)}{g'(a)}$. (d) L'Hopital's Rule for $0/0$ form. (e) If f, g be two functions such that

(i) $\lim_{x \rightarrow \infty} f(x) = \lim_{x \rightarrow \infty} g(x) = 0$ and (ii) $f'(x), g'(x)$ exist and $g'(x) \neq 0$ for all $x > 0$ except

possibly at ∞ , and (iii) $\lim_{x \rightarrow \infty} \frac{f'(x)}{g'(x)}$ exists, then $\lim_{x \rightarrow \infty} \frac{f(x)}{g(x)} = \lim_{x \rightarrow \infty} \frac{f'(x)}{g'(x)}$ (f) L'Hopital's Rule for ∞/∞

form. Point of inflexion

Reference: Chapter 7 in [3]. Also Chapter 4 and 7 in [4]

References

- [1] Shanti Narayan, **Differential Calculus**, S.Chand & company (pvt)Ltd. 1988.
- [2] N.Piskunov, **Differential and Integral Calculus**, Vol.I, Translated from the Russian by George Yankovsky, CBS publishers & distributors, 4596/1A, 11 Darya Ganj, New Delhi-110 002.
- 1) S.C.Malik and Savita Arora, **Mathematical Analysis**, second edition, Wiley Eastern Ltd, 1994.
- 2) Tom Apostol, **Calculus Vol. I**, Second Edition, Wiley Students Edition, India, 2012

BSEDMATHS 102 : ANALYTICAL GEOMETRY

1 Analytic Geometry of two Variables.

General Equation of Second Degree. Equation $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$
Transformation of Co-ordinates. Change of Origin and Rotation of Axes. To show that the
general second degree equation represents. (a) Ellipse if $h^2 < ab$. (b) Parabola if $h^2 = ab$. (c)
Hyperbola if $h^2 > ab$. (d) Circle if $a = b$ and $h = 0$. (e) Rectangular Hyperbola if $a + b = 0$. (f)
Two straight lines if $\Delta = 0$. (g) Two parallel straight lines if $\Delta = 0$ and $h^2 = ab$,

$$\text{where } \Delta = \begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix}.$$

2. Conic sections.

Standard equations of conics using focus-directrix property. Parametric equations of
standard conics. Tangent at a point (x_1, y_1) . Tangents in terms of slope. Tangent in terms of
parametric co-ordinates. Condition of tangency. Properties of i) Parabola ii) Ellipse and iii)
Hyperbola as listed in **Annexure 1**. Center of a Conic, Central Conic. Tangents and Normals.
Pole & Polar with respect to conic.

3. Three Dimensional Geometry: Prerequisites:

Direction Cosines, direction ratios. Equations of lines, planes, intersection of two planes,
symmetric forms of equation, lines perpendicular to planes, angles between two lines and
between a line and a plane. Projection of a line on a plane. Sphere: Intersection of a sphere
by planes, intersection of two spheres

4. Central conicoids:

Shapes, ellipsoids, hyperboloid of one sheet, two sheets. Intersection of
a conicoid and a line. Cone and right cylinder. Standard equations

References

- [1] S. L. Loney; The Elements of Co-ordinate Geometry part I Cartesian Coordinates; subject
publications 1990.
1. P.K.Jain, Khalil Ahmed: Textbook of Analytical Geometry of three Dimensions, second
edition, Wiley, Eastern Limited, 1991.
 2. M.L. Khanna: Solid Geometry; Jai Prakash Nath and Co.1988.
 3. Tom Apostol , **Calculus Vol. I** , Second Edition, Wiley Students Edition , India, 2012

Semester II

BSEDMATHS 201: Discrete Mathematical Structures.

1. Propositional Calculus (Chapter 1. Last section only)
2. Graphs (Chapter 5.)
3. Trees (Chapter 6.)
4. Discrete Numeric Functions (Chapter 9.)
5. Recurrence Relation and Recursive Algorithms. (Chapter 10.)
7. Boolean Algebra (Chapter 12.)

Principal Text :

C.L.Liu: Elements of Discrete Mathematics,
McGraw-Hill International Editions, 1996.

References:

1. Kolman Busby and Ross: Discrete Mathematical Structures, PHI.
1. Rosen: Discrete Mathematics and Application, TMH
2. Schaum Series : 2000 Problems in Discrete Mathematics.
3. Schaum Series : Discrete Mathematical Structures.
4. Narsingh Deo : Graph Theory with Application to Computer Science.

BSEDMATHS 202: Probability & Statistics*

Review of Probability and Random experiments. Theorems of total and compound probability. Total probability for n events (Statement only) Bayes' theorem, application problems.

Random Variables (Discrete and Continuous)- Probability, Distribution-Probability Density Functions- Mathematical Expectation- Functions of Random Variables. Joint Probability distribution. Marginal distribution function. Mathematical expectations and Generating Functions. Characteristic function.

Binomial and Poisson Distribution- Moments and Moment Generating Functions of these distribution and their simple properties- Recurrence Relations for moments of the Binomial and Poisson distributions. Fitting of Binomial and Poisson Distribution. Normal Distribution and its properties. Statement of the Lindberg-levy Central Limit Theorem.

Sampling and Large Sample Tests. Z test and Student's t test . the significance of sample mean, difference between two sample means, Variances. Snedecor's 'F' Distributions

Chi- square Distribution. Applications of the Chi-square Distribution-Tests of Goodness Fit-Contingences Tables.

Principal Text:

S.C.Gupta & V.K .Kapur – Fundamentals of Mathematical statistics (S.Chand)

Articles : 4.6 - 4.9 , 5.1 – 5.5.5 , 6.1 – 6.10 (omit 6.10.1-6.11.2), 6.12, 6.13, 6.17, (Omit 6. 12.1 - 6.12.3), 7.0 – 7.2.8 , 7.2.11,7.3.9 -7.3.10, 8.2 -8.2.14, 8.10, 8.10.2 (omit 8.2.6)

Chapter 12, Chapter 13 upto 13.8 {Omit 13.3.1,13.3.2
} Chapter 14 upto 14.2.10, 14.5- 14.5.5.

Reference Text

- 1) Tom Apostol , **Calculus Vol. II** , Second Edition, Wiley Students Edition , India, 2012. [Chapters 13 & 14]
- 2) Hogg and Craig: Mathematical Statistics
- 3) S.P.Gupta : Statistical Methods

Semester III

BSEDMATHS 301 : Numerical Methods

Elementary Error Analysis : Introduction. Numbers: Exact and Approximate. Significant digits. Errors: Absolute, Relative and Percentage errors. Examples

Calculus of Finite differences:

Operators Δ , ∇ & E . Difference Tables. Properties of Δ , ∇ , & E . Fundamental Theorem of Difference Calculus. Expression of any value of a function in terms of leading term and leading differences of a difference table. Method of separation of symbols.

Interpolation and Extrapolation:

.Newton's forward and backward interpolation formulae. Lagrange's Interpolation formula
.Newton's Divided Difference formula.
Examples based on the above formulae.

Numerical Differentiation and Integration: Differentiation formulae for equidistant arguments. Examples. General quadrature formula for equidistant ordinates (Newton –Cotes Formula Or Gauss Legendre quadrature formulae).

Trapezoidal rule and its Geometrical interpretation. Simpson's one third rule, Simpson's three-eighth rule. Weddle's rule (Only Statements)

Solution of Algebraic and transcendental Equations: Introduction. Method of Bisection, Regula-Falsi Method, Newton-Raphson Method and their Computation scheme. Special Cases of Newton-Raphson Method like finding q^{th} root of a positive real number 'd' and finding reciprocal of a positive real number 'd' without using division.

Approximations:

The least square polynomial approximation method (Linear, quadratic, Exponential)

Practicals:

- 1) Newton-Gregory Forward and Backward Interpolation Formulae.
- 2) Lagrange's Interpolation Formula for unequal intervals.
Newton's Divided difference formula for unequal intervals

- 3) Numerical Differentiation: Using Differentiation formulae for equidistant arguments
- 4) Numerical Integration: Trapezoidal rule, Simpson's one third rule and Weddle's rule
- 5) Solution of Algebraic and transcendental equations by the Bisection method.
- 6) Solution of Algebraic and transcendental equations by the Regula Falsi method and the Newton–Raphson method.
- 7) The least square polynomial approximation (Linear and quadratic)
- 8) The least square polynomial approximation (Exponential)

Note: Use Public domain software's like KASH and SCILAB is recommended.

References:

- 1) Introduction to Numerical Analysis : F.B.Hilderband
- 2) Introduction to Numerical Analysis . Atkinson
- 3) Numerical methods: Problems & Solutions . M. K. Jain, Iyengare Jain (Wiley)
2. Calculus of Finite differences & Numerical Analysis : Gupta & Malik, Krishna Mandre, Prakashan Meerud
13. Introduction to Numerical Analysis : S.A.Mollah, New Central Book Agency Pvt. Ltd.
14. Tom Apostol , **Calculus Vol. II** , Second Edition, Wiley Students Edition , India, 2012. [Chapter 15]

BSEDMATHS 302 : CALCULUS OF TWO VARIABLES

1. FUNCTIONS OF TWO VARIABLES

Function of two variables, neighbourhood of a point, limit point, limit of a function, non-existence of limit, Algebra of limits, repeated limits, continuity, partial derivatives, differentiability, partial derivatives of higher order, change in the order of partial derivation, the derivation of a composite function (chain rule), change of variables, Extreme values, maxima and minima, sufficient condition for $f(x, y)$ to have an extreme value at (a,b). Lagrange's Multipliers. Theorems: (a) Mean value theorem (b) Sufficient condition for continuity. (c) Sufficient condition for differentiability.(d) sufficient condition for the equality of f_{xy} and f_{yx} : Young's theorem and Schwarz's theorem. (e) Taylor's theorem; Maclaurin's expansion.

2.INTEGRATION ON R^2

Line integrals, plane curves, properties of line integrals. Double integrals, partition of a rectangle, integration over a rectangle.

Statements (only) of the following:

(a)Condition of integrability, integrals as a limit of sums, integrable functions (continuous function is integrable, bounded function with finite number of discontinuity is integrable etc.) (b)Repeated integrals, Calculation of double integral over a rectangle (reduction to repeated integrals). (c) Fubini's theorem. (d) Leibnitz's rule.(e) General Leibnitz's rule. (f) Two repeated integrals are equal. Double integrals over a region, Integrability over a bounded domain, reduction to iterated integrals. Change of variables and problems. Volume of a cylindrical solid by double integrals, volume enclosed by two surfaces, volume enclosed by closed surface.

References

18. N.Piskunov, **Differential and Integral Calculus**, Vol. II, Translated from the Russian by George Yankovsky, CBS publishers & distributors, 4596/1A, 11 Darya Ganj, New Delhi-110 002.
19. S.C.Malik and Savita Arora, **Mathematical Analysis**, second edition, Wiley Eastern Ltd, 1994, (Chapters 15,16,17)
- [3]. Tom Apostol, **Calculus Vol. II**, Second Edition, Wiley Students Edition, India, 2012.
[Chap. 8,9 11]

Semester IV

BSEDMATHS 401: MATRIX ALGEBRA *

1. Vectors and operations with vectors in \mathbb{R}^3 and generalization to \mathbb{R}^n . Linear combinations. Linear dependence and independence. Basis, Linear span and dimension.
2. Elementary operations on a matrix: Elementary matrices. Effects of multiplying by these on a matrix. Equivalence of matrices: Row/column equivalence, Echelon forms. Normal form.
3. Rank of a matrix: Definition using minors. Finding rank of a matrix using definition. (upto 3x3 only) Theorem: Elementary operations do not change the rank of a matrix. Finding the rank using echelon forms. Linear Independence of Row and Column Matrices. Definition of rank of a matrix using independence of Row or column vectors. Equivalence of two definitions of Rank.
4. Application of matrices. Solutions of a system of linear equations. Characteristic Values of a Matrix. Caley-Hamilton Theorem. Diagonalisation of a matrix up to order 3 (when eigenvalues are distinct).

PRACTICALS (Using C++)

- 1) Addition of matrices, Scalar multiplication and finding Determinant of a square matrix.
- 2) Multiplication of matrices.
3. Inverse of a square matrix using the formula $A^{-1} = \frac{1}{|A|} \text{Adjoint of } A$
2. Reduction of a matrix to the Echelon form and to find it's Rank.
3. Inverse of a matrix using row reduction.
4. Solution to a system of equations using Gaussian elimination.
5. Finding Eigen values and Eigen vectors of a matrix.
6. Diagonalization of a matrix and use it to find the powers of the matrix.

Note: Use Public domain soft wares like KASH and SCILAB is recommended.

References

- * K.B. Dutta; Matrices and Linear Algebra, Prentice Hall India
- * N. Ch. Iyengar: Matrices, Anamol Publications Pvt Ltd, 1998.
- * Gilbert Strang: Introduction to Linear Algebra and its Applications, Thomson Books/cole. 1986.

- * Hadley G. Linear Algebra, Narosa PH. 1988.
- * Tom Apostol , **Calculus Vol. I & II** , Second Edition, Wiley Students Edition , India, 2012

Semester IV

BSEDMATHS 402: Differential equations I

Review of basic concepts. Differential equation of the first order homogeneous, non-homogeneous, exact differential equations, conditions for exactness, integrating factors, integrating factors by inspection and rules for finding integrating factors, linear equations. Equations reducible to the linear form. Equations of first order, but not of first degree. Bernoulli's equation. Clairaut's form and equations reducible to it. Ricatti's equation. Applications. Modelling with differential equations.

Statement of sufficiency conditions for the existence and uniqueness of a solution of non-homogeneous differential equation $y'' + p(x)y' + q(x)y = r(x)$ together with the initial conditions $y(x_0) = y_0$; $y'(x_0) = y_1$.

Theorem: The dimension of the solution space of the homogeneous differential equation $y'' + p(x)y' + q(x)y = 0$ is two. General solution of the homogeneous equation. Characteristics Equation of a homogeneous differential equation with constant coefficients of order two and computation of linearly independent solutions. Wronskian. Use of known solution to obtain another linearly independent solution. Method of undetermined coefficients. Variation of parameters Formula. Extension of methods to n order. Applications of second order linear differential equation. (Models)

D-operator Method to solve linear differential equation with constant coefficients. $f(D)y = 0$. Solution for different types of roots. Inverse D-operator. Solution of $f(D)y = X$ where $X = \exp(kx)$, $\cos(kx)$, $\sin(kx)$, polynomials in x and their products.
 $\{1/(D^2 + a^2)\} f(x)$, where $f(x) = \sin ax$, $\cos ax$.

Numerical solutions of ordinary differential equations. Euler's method. Taylor's series method. Picard's method of successive approximations.

References

- 1) Ordinary Differential Equations-G.F.Simmons (Tata McGraw Hill).
- 2) Advanced Engineering Maths- Kreyszig (wiley Eastern)
- 3) Differential Equation and Application –M.Braun (Narosa)
- 4) Ordinary Differential Equations – E.A.Coddington
- 5) Ordinary Differential Equations- Deo, Lakshmikantam & Raghvendra.
- 6) Numerical methods by Jain & Krishnamurthy.
- 7) Tom Apostol , **Calculus Vol. II** , Second Edition, Wiley Students Edition , India, 2012 [Chapter 6]

Semester V :

BSEDMATHS 501: Analysis I

Sequences and series

1 Sequences in \mathbb{R} : Bounded Sequences, Algebra of sequences, Convergence of sequences, Sub sequences, monotone sequences, Cauchy sequences, Bolzano – Weierstrass theorem, Cauchy's General Principle of Convergence. Sequences in \mathbb{C} and \mathbb{R}^2 .

2 Series (Real and Complex): Examples. Positive term series, Geometric Series, Power series, Alternating Series. Convergence of series. A necessary condition for convergence. Cauchy's General principle of Convergence, Absolute Convergence, Conditional Convergence, Comparison test for positive term series, Ratio test, Cauchy's root test, Leibnitz test for Alternating series.

Sequences and series of functions:-

3 Examples of Sequences of real-valued functions, point wise and uniform convergence of sequences and of series of real valued and complex Valued functions defined on a subset of \mathbb{R} ,

Cauchy's Condition for uniform convergence of a sequence of functions, Continuity of the uniform limit function, uniform convergence. Properties of Boundedness, Integrability and Differentiability of the limit function.

4 Term by term integration and differentiation of series of functions from $\mathbb{R} \rightarrow \mathbb{R}$. Comparison test. Uniform convergence of Infinite series of functions. Cauchy's condition for uniform Convergence of series. Weierstrass's M-test for Uniform convergence. Dirichlet's test for uniform convergence. Uniform convergence and term by term integration and differentiation. Examples of non-uniformly convergent series that can be integrated term by term.

Principal Text:

S. C. Malik & Arora.

Principles of Mathematical Analysis

References:

- | | |
|---------------------|---|
| 1. Goldberg R.R. | Methods of Real Analysis |
| 2. Procter & Morrey | Analysis |
| 3. Walter Rudin | Principles of Mathematical Analysis |
| 4. T. Apostol | Mathematical Analysis |
| 5. R. Bartle | Elements of Real Analysis |
| 6. Das & Patnayak | Principles of Mathematical Analysis |
| 7. Tom Apostol , | Calculus Vol. I , Second Edition, Wiley Students Edition , India, 2012 |

BSEDMATHS 502: Algebra

1 Sets, Relations and mappings, equivalence relations, partitions. Binary operations and their properties. Divisibility in the set of integers.

Congruence modulo n , residue classes, addition and multiplication modulo n , Roots of unity.

2 Groups (definition and examples). Simple properties, subgroups, cyclic groups. Coset decomposition. Lagrange's theorem and its consequences. Fermat's and Euler's theorems.

Homeomorphisms and isomorphisms of groups.

3 Normal subgroups, quotient groups. Fundamental theorem of group homomorphism.

Permutation group, even and odd permutations, alternating group, Caley's theorem. Rings, Integral domain, Division rings and Fields.

4 Subring of a ring, characteristic of a ring, ideals. Homomorphism and isomorphism of rings, quotient rings. Fundamental theorem of ring homomorphism.

Principal Text :

J.B. Fraleigh : A First Course in Abstract Algebra

References

1. N.S. Gopalkrishnan: University Algebra
2. I.N. Herstein : Topics in Algebra.
3. J Gallian : Abstract algebra

BSEDMATHS 503: Analysis II

1 Riemann Integral: Partition of an interval-properties of partitions- Upper and lower sums of a bounded real valued function over a closed interval-Riemann Integrability- Necessary and sufficient conditions.

2 Riemann Integrals of Step, monotonic and continuous functions. Integrability of the absolute value, sums, scalar multiples of Riemann integrable Functions. Integrability of products, quotients and composition of functions.

Theorems: (i) $\int_a^c f(x) dx + \int_c^b f(x) dx = \int_a^b f(x) dx$, $a \leq c \leq b$

(ii) $\int [f(x) \pm g(x)] dx = \int f(x) dx \pm \int g(x) dx$.

(iii) $\int c f(x) dx = c \int f(x) dx$

(iv) $\int_a^b f(x) dx = - \int_b^a f(x) dx$

3 Continuity and differentiability of the integral as a function of the upper limit . Fundamental theorem

of Calculus and the Mean Value Theorem for the Integral.

4 Improper integrals of both types. Beta and gamma functions (basic definitions and simple properties.)

Principal Text:

S.C. Malik and Arora : Mathematical Analysis

References:

1. R. Goldberg : Real analysis
2. Bhat R.D. : Mathematical Analysis II
3. R.B. Bartle : Introduction to Real analysis
4. Tom Apostol , **Calculus Vol. I** , Second Edition, Wiley Students Edition , India, 2012

Semester VI :

BSEDMATHS 601: Linear Algebra

1 : Vector space [Definition and examples], subspaces, sum and direct sum of subspaces. Linear span, linear dependence, independence and their properties. Basis, existence theorem for basis, dimension of a vector space , finite dimensional vector spaces. Dimension of sum of subspaces. Existence of complementary subspace of a finite dimensional vector space. Quotient space and its dimension.

2 Linear transformation, Fundamental theorem of Linear transformations . Vector space homomorphism, Matrix representation of linear transformation. Rank nullity theorem.

3 Eigen values and eigen vectors of a linear transformation on a finite dimensional vector space. Eigen values of square matrix. Eigenspace. Cayley- Hamilton theorem. Diagonalisation of an $n \times n$ matrix over \mathbb{R} [**15 lectures; 20 marks**]

4 Inner products spaces. Cauchy- Schwarz inequality, orthogonal vectors, orthogonal complement, orthogonal sets and bases, Gram-schmidt orthogonalisation , Bessel's inequality,

Principal Text:

Krishnamurty and others : Linear Algebra

References:

- a) K.B.Datta : Matrix and Linear Algebra
- b) K.Hoffman and R. Kunge : Linear Algebra
- c) Schaum's series : Linear Algebra
- d) S. Kumaresan: Linear Algebra :a geometric approach
- e) Tom Apostol , **Calculus Vol. II** , Second Edition, Wiley Students Edition , India, 2012
[Chapters 1,2 and 4]
- f) Gilbert Strang: Introduction to Linear Algebra and its Applications, Thomson Books, 4th edition

BSEDMATHS 602: Metric Spaces**1** Definition and examples of metric spaces.

Open ball and open sets, closed set as complement of an open set. Properties of closed sets and open sets. Limit points of a set, closure of a set, dense sets.

2 Subspace of a metric space. Convergence of a sequence in a metric space, Cauchy sequences. Continuous functions from a metric space X to a metric space Y (ϵ - δ definition), their characterization in terms of open sets, closed sets, closure and convergent sequences.**3** Complete metric space, completeness of a closed subspace of a complete metric space, Cantor's Intersection Theorem.

Contraction mapping, Fixed point theorem and its application to Picard's existence theorem for solution of a first order differential equation.

4 Connectedness in a metric space, Theorems on connectedness, Connected subsets of \mathbb{R} . Intermediate Value Theorem.**Principal Text :**

E.T.Copson : Metric spaces, Cambridge University Press

References:

- i) P.K. Jain and K. Ahmad : Metric spaces, Narosa Publishing House.
- ii) S. Kumaresan : Topology of Metric Spaces Narosa Publication House.

BSEDMATHS 603: Complex Analysis.**1** Complex Numbers: Algebraic Properties of Complex Numbers, Modulus, Argand Diagram, Exponential Form and Polar Co-ordinates ,Triangle inequality and Metric properties, Connectedness of regions.

(Chapter 1.) (Analytic Functions: Complex and functions on Complex domain, Limits continuity of Complex valued function on a Complex domain, Differentiability and analytic Functions, Algebra of Differentiability, Cauchy-Riemann Equations, Sufficient condition for Differentiability, Harmonic Functions. (Chapter 2.)

2 Elementary Function: Exponential Function, Logarithmic

Function and its Branches, Trigonometric Functions, Hyperbolic Functions. (Chapter 3.)

3 Contour Integration: Contours and Contour Integrals, Cauchy Goursat's theorem (with out proof), Simply Connected Domains, Cauchy's Integral Formula, Higher Derivatives of Analytic Functions, Liouville's Theorem, Fundamental Theorem of Algebra, Maximum Modulus Principle. (Chapter 4.)

Series: Convergence of Series, Taylor Series, Laurent Series. (Chapter 5. First three sections on the above topics)

4 Residue Theory: Singularities of a Function, Poles and essential singularity, Residues at a singular point and its Computation, Residue Theorem

Principal Text

J.W.Brown and R.V.Churchil : Complex Variables and Applications
Sixth Edition, McGraw-Hill International Editions, 1996.

References:

- i) A.R Shastri: Complex Analysis
- ii) Karunakaran: Complex analysis
- iii)Schaum's Series: Complex Analysis.
- iv)J.B. Conway; Functions of a Complex Variable.
- v) S. Ponnuswamy: Complex Analysis. Narosa.
- vi)Sarason: Complex Analysis
- vii) Tom Apostol , **Calculus Vol. I** , Second Edition, Wiley Students Edition , India, 2012

[Chapter 9]

Semester VII :

BSEDMATHS 504: Vector calculus *

1 Vector valued functions of a single variable. Their limits, continuity, derivatives and integrals. Space curves in \mathbb{R}^3 . Smooth and Regular curves. Arc-length parameter. Reparametrisation of curves. Tangent, Normal and Binormal vectors. Equations of tangent line and normal line. Torsion and Curvature. Serret-Frenet formula. Equations of fundamental planes.

2 Level surfaces. Scalar and vector fields. Vector differential operator. Gradient of scalar field and its properties. Directional derivatives. Curl and Divergence of vector field. Properties of curl and divergence. Irrotational and solenoidal vector fields. Identities on gradient, curl and divergence. Physical significance of gradient, curl and divergence. Laplacian operator.

3 Spherical and Cylindrical coordinates. Line integrals and its properties. Physical significance of line integrals. Independence of path. Problems on line integrals. Greens theorem(with proof) and its applications.

4 Surface and volume integrals. Stokes theorem(with proof) and its applications. Gauss divergence theorem(with proof)and its applications.

References:

1. Murray and Spiegel: Theory and Problems of Vector Analysis, SI (metric) edition, Schaum's Outline Series.
2. A.R. Vasishtha; Text book on Vectors, Krishna Prakashan Mandir (P) Ltd. 11, Shivaji Road, Meerut-250001(U.P),India.
3. J. N. Sharma and A.R.Vasishtha; Vector Calculus, Krishna Prakashan Media (P) Ltd.11,Shivaji Road, Meerut-250001(UP) India.
4. Shanti Narayan and J.N.Kapur; A text book of Vector Calculus, S. Chand & Company (Pvt.) Ltd, Ram Nagar, New Delhi-110055.
5. MD, Ali Ashraf and MD. Abdul Khaleq Hazra; Vector Analysis with Application, Third edition, Wiley Eastern limited.
6. Gosh and Maity; Vector Analysis, New Central book agency (P) LTD.
7. Tom Apostol , **Calculus Vol. I & II** , Second Edition, Wiley Students Edition , India, 2012

BSEDMATHS 505 : Number Theory*

1) Divisibility: Divisibility Primes. Congruences, solution of congruences, Chinese Remainder Theorem Fermat Theorem, Wilson's theorem Congruences of degree 1

2) Some Functions of Number Theory: , the function $\phi(n)$, Greatest integer function formula, the multiplication of Arithmetic functions,

3 Quadratic Residues, Quadratic reciprocity, Jacobi symbol.

Some Diophantine Equations: the Equations $ax + by = c$, the equation $x^2 + y^2 = z^2$, the equation $x^4 + y^4 = z^4$, sum of Four and five squares.

4 Simple continued fractions, Infinite continued fractions, Periodic continued fractions. Fibonacci numbers.

Principal text: *Elementary Number Theory* By David Burton
Sixth edition Tata McGraw-Hill Edition

(Chapt. 2, 3 (section 3.1), 4 (sections 4.2, 4.4), 5 (Section 5.2 concerning Fermat's Theorem only, section 5.3), Chapt. 6 (section 6.1-6.3), Chap. 7 (Section 7.2, 7.4) Chapt. 9 (Section 9.1-9.3) Chapt. 12 (section 12.1, 12.2 (Theorem 12.3) Chapt. 15.2-15.3 Chapt. 14 (section 14.2)

References:

4. *An Introduction to the Theory of Numbers*
By I. Niven, H.S. Zuckerman and H. L. Montgomery,
Fifth edition, Wiley-India
5. *Elementary Number Theory with Applications* By Thomas Koshy
Second edition Elsevier India Pvt Ltd, 2005

BSEDMATHS 506: Operations Research I *

1 Definition of standard form, formulation of LPP, convex set and extreme points of convex sets. (Only definitions) and examples . Graphical method (Only two variables).

2 Simplex Method: Theorems related to simplex method .and problems .Cases pertaining to existence of multiple solutions, unbounded and no feasible solution. Artificial techniques: Big M method and Two phase Simplex method

3 Duality, theorems on duality, linear programming problems with unrestricted variables. Dual simplex method. Revised simplex method.

4 Post – Optimal Analysis: Effects of change in the component of the cost vector and requirement vector, parameterization of the cost vector and requirement vector.

Principal Text :

Kantiswarup, P.K.Gupta & Man-Mahon: Operations Research

References:

- 1) H.Taha- Operations Research
- 2) Mittal & Goel—Operations Research
- 3) J.K.Sharma- Mathematical Methods in Operations Research

Semester VIII :

BSEDMATHS 604: Analysis III

1: Weierstras's polynomial Approximation theorem. Power series in \mathbb{R} , their domain of Convergence, and Uniform convergence- term by term differentiation and integration of power series in \mathbb{R} .

Power series definitions of Exponential, Logarithmic and trigonometric functions, their properties.

2 Inner product : $(f, g) = \int f(x) g(x) dx$. Norm of f . Orthogonal system of functions. (Orthogonal and orthonormal sequences of functions).

3 Fourier series of real functions on $(-\pi, \pi)$ and $(0, \pi)$. Fourier coefficients, properties of Fourier coefficients, the Fourier series of a function relative to an orthonormal system. Bessel's inequality. Trigonometric Fourier series, Fourier series of odd & even function. Fourier series from power series.

4 Integration & differentiation of Fourier series at a point. Fourier theorem. Norm in $C[a, b]$. Cauchy-Schwartz inequality. Fourier Series of real functions on $(c, c+2l)$ Riemann-Lebesgue Lemma. Parseval's identity.

Principal Text :

S. C. Malik : Principles of Mathematical Analysis

References:

1. Golberg R.R. Methods of Real Analysis
2. R . Bartle Elements of Real Analysis
- 3 T. Apostol Mathematical Analysis
5. G.S.Sharma Engineering Mathematics
6. D. Somasundaram A first course in mathematical analysis
7. Tom Apostol , **Calculus Vol. I** , Second Edition, Wiley Students Edition , India, 2012

BSEDMATHS 605 : Differential Equations II

1 Differential equations with Variable Coefficient which are analytic. Power series method. Legendre equation. Equation with regular singular points, exceptional cases. Bessel equation. Regular singular point at infinity. Gauss hypergeometric equation. Properties of Legendre Polynomial & Bessels functions. Laguerre equation,

Tchebychev equations. Hermit equation. Euler equation.

2 System of 1st order differential equations. Conversion of nth order equation to 1st order system . Existence and uniqueness of solution (statement only). Methods of solution for Linear system . Homogeneous and non homogeneous equations with constant Coefficients . D operator method.

3 Laplace Transformation:-Introduction to Laplace Transformations –Laplace transformation of elementary functions- Laplace transformation of periodic functions- inverse Laplace transformation- Convolution Theorem. Solution of first order and second order linear differential equations with constant coefficients using Laplace transformation.

4 Numerical solution of differential equations. Multistep method . Predictor – corrector method Runge Kutta of order 2 and 4 . System of differential equations .

Principal Text:

G.F.Simmons : Differential equations with historical notes . TMH

References:

- i) E.A.Coddington : An introduction to Ordinary Differential equations. PHI
 - ii) S.G.Deo, Lakshmikantham, Raghavendra : A text book of Differential equations .
 - iii) Schaum's Series : Laplace Transform
 - iv) S. Sastry: Numerical analysis
 - v) Tom Apostol , **Calculus Vol. II** , Second Edition, Wiley Students Edition , India, 2012
- [Chapters 6]**

BSEDMATHS 606 : Operations Research II *

1 Queuing Theory:

Queuing system and its characteristics, Poisson Process, Exponential process, classification of queues – Transient and steady states, (M/M/C) : (∞ /FIFO) , (M/M/1) : (∞ /FIFO) . Queuing system.

2 PERT/CPM: Concepts of network, construction of network, Time estimates, CPM calculation, various floats, PERT calculations.

Transportation Problems: Mathematical formulation, condition for existence of feasible solution, rank of transportation matrix, Initial basic feasible solution by (i) NWC method (ii) Matrix-minima and (iii) VAM, Modi's method to find an optimal solution, balanced and unbalanced transportation problems.

3 Inventory Control:

Basis concepts of Inventory control, definition of inventory costs and other factors, Deterministic inventory problem (3 cases), Probabilistic inventory problems (discrete & continuous units)

4 Dynamic Programming;

Bellman's principle of optimality, recursive equation approach, characteristics of Dynamic programming, computational procedure in dynamic programming, multi-stage decision problems, solution of linear programming problem using dynamic programming

Assignment Problems: Mathematical formulation, Hungarian methods to solve assignment problems, balanced & unbalanced assignments problems

Principal Text:

Kantiswarup, P.K.Gupta & Man-Mohan : Operations Research

References :

1. H. .Taha- Operations Research
- 2 Mittal & Goyal- Operations Research

***Revised and New Syllabus**

Syllabus of B.Sc.B.Ed

(PHYSICS)

Goa University through its affiliated colleges offers a full-time three year (six semester) Bachelor's programme in Physics.

The programme aims at imparting undergraduate education in Physics and preparing those who intend to pursue higher studies in Physics.

The prerequisites of the B.Sc. programme in Physics are a pass at Higher Secondary School Certificate Examination conducted by Goa Board or its equivalent.

In addition to the Physics syllabus given below, a student has to opt for two other subjects in Semesters I to IV. It is advised that one of these subjects be Mathematics. The course requirement also specifies additional courses like Environmental Science, Foundation Course, etc.

While laboratory experiments are linked to theory course in Semesters I to IV, Semester V and VI have two separate practical courses. In order to be eligible for B.Sc. degree, a student has to pass individually in all papers of Physics as well as other opted courses.

In this six semester programme, a student has to complete a Project in the sixth semester. He can also opt for two special skill based courses in semester V.

The table on the next page lists the courses under the programme. The semester-wise distribution of the courses is also given. Description of each of the courses is given in subsequent pages.

B. Sc. (Physics) List of Courses

No	SEM	PAPER	TITLES
F. Y. B. Sc.			
1.	I	BSEDPHY 101	Mechanics and Properties of Matter
2.		BSEDPHY 102	Electricity
3.	II	BSEDPHY 201	Waves and Acoustics
4.		BSEDPHY202	Optics
S. Y. B. Sc.			
1.	III	BSEDPHY 301	Mechanics II
2.		BSEDPHY 302	Electronics
3.	IV	BSEDPHY 401	Heat and Thermodynamics
4.		BSEDPHY 402	Modern Physics
T. Y. B. Sc.			
1.	V	BSEDPHY501	Electronics
2.		BSEDPHY 502	Wave Mechanics*
3.		BSEDPHY503	Nuclear Physics
1.	VI	BSEDPHY601	Electromagnetic Theory I*
2.		BSEDPHY602	Practical I (Section1 and Section2)
3.		BSEDPHY603	Practical II* (Section1 and Section2)
4.		BSEDPHY SK 604	Electrical and Electronics Instrumentation
5.		BSEDPHY SK 605	Computational Physics
Fourth. Y. B. Sc.			
1.	VII	BSEDPHY 701	Solid State Devices and Instrumentation
2.		BSEDPHY 702	Atomic and Molecular Physics*
3.		BSEDPHY 703	Thermodynamics and Statistical Mechanics
1.	VIII	BSEDPHY 801	Electromagnetic Theory II and Relativity*
2.		BSEDPHY 802	Practical I(Section1 and Section2)
3.		BSEDPHY 803	Practical II*(Section1 and Section2)
4.		FINAL PROJECT	Physics Project

Note: Papers indicated with ‘*’ mark for students with three units.

Semester – I

BSEDPHY 101: MECHANICS AND PROPERTIES OF MATTER

Motion of a particle in one dimension

Discussion of the general problem of one dimensional motion. Dependence of force in general on position, velocity and time. Motion under a constant force with illustrations-Atwood's machine, Free fall near the surface of the earth. Motion along a rough inclined plane. The equation of motion, momentum and energy conservation theorems. Motion under a force which depends on time-general approach to the solution. Illustration using force of the type $F = F_0 \sin(\omega t + \phi)$. Motion under a conservative force dependent on position, potential energy. Brief review of simple harmonic motion [Idea of first integral, energy integral, constant of motion and neutral equilibrium to be discussed]. Motion under damping force depending on velocity - general dependence of resistive force on velocity. Motion in a medium with resistive force proportional to first power of velocity [Ignoring gravity]. Body falling under gravity in a resistive medium near the surface of the earth.

Motion of a charged particle in Electro-magnetic field (Only perpendicular field)

Motion of a charged particle in a uniform constant (1) electric field, (2) magnetic field. Motion of a charged particle in a uniform constant electric field and magnetic field (crossed) in mutually perpendicular directions. Lorentz force.

Motion in two dimension :

Equations of motion in plane polar coordinates [Equations Nos.3.72- 3.80 from Mechanics, Symon]. Momentum and energy theorems. Plane and vector angular momentum theorems.

Motion of a particle in a plane:

Projectile motion in a non-resistive and resistive medium, resistive force proportional to the first power of velocity.

Properties of Matter

Elasticity:

Moduli of elasticity, Poisson's ratio and relationship between them. Bending of beams-bending moment, flexural rigidity. Cantilever (rectangular bar). Depression of a beam supported at the ends and loaded at the center. A vibrating cantilever. Torsion in a string-couple per unit twist, Torsional Pendulum.

Surface Tension:

Brief review of molecular theory of surface tension. Relation between surface tension and surface energy. Angle of contact. Capillarity-rise of liquid in a capillary tube.

Viscosity:

Streamline flow, Turbulent flow, Critical velocity, Coefficient of viscosity, Poiseuille's formula for flow of liquid through a capillary tube.

- 3) Mechanics (3rd Ed.), by K. R. Symon Chapter 1, Section 1.7(eq:1.8 to 1.47), Chapter 2, Section 2.1, 2.2, 2.3 (up to eq:2.19), 2.4(eq:2.32 to 2.38), 2.5, 2.6(eq:2.64 to 2.72 and eq:2.76 to 2.86), 2.7 (Motion of a particle in one dimension)
- 4) Mechanics (3rd Ed.) , by K. R. Symon Chapter 3, Section 3.17 (Motion of a charged particle in Electro-magnetic field (Only perpendicular field))
- 5) Mechanics (3rd Ed.), by K. R. Symon Chapter 3, Section 3.4 (eq:3.72 to 3.80), 3.7, 3.8 (Motion in two dimension)
- 6) Mechanics (3rd Ed.), by K. R. Symon Chapter 3, Section 3.11 (eq:3.154 to 3.175) (Motion of a particle in a plane)
- 7) Elements of Properties of Matter, by D. S. Mathur, Chapter 8, Section 8.8, 8.9, 8.12, 8.13, 8.14, 8.15, 8.16, 8.17, 8.18, 8.22, 8.26, 8.29, 8.30(a(i)), 8.32, 8.33(i) (for Elasticity)
- 8) Elements of Properties of Matter, by D. S. Mathur, Chapter 14, Section 14.1, 14.2, 14.3, 14.4 14.6, 14.8, 14.14, 14.15 and 14.17 (for Surface Tension).
- 9) Elements of Properties of Matter, by D. S. Mathur, Chapter 12, Section 12.1, 12.2, 12.7, 12.11 (for Viscosity).

Books

4. Introduction to Classical Mechanics, R. G. Takawale and P. S. Puranik, Tata McGraw-Hill (1997)
5. Properties of Matter, Brijlal and N. Subrahmanyam S. Chand (1999)
6. Mechanics, K. R. Symon, Addison Wesley (1971)
7. Berkeley Physics Course, Volume I, Mechanics, McGraw-Hill (1973) (C. Kittel, W. D. Knight, M. A. Rudderman, A. C. Helmhotz and B. J. Moyer)
8. Properties of Matter, Starling H. S, Mcmillian and Co (1961).
9. Mechanics , H.S.Hans and S.P.Puri, Tata McGraw-Hill (2003)
10. Mechanics, D.S.Mathur, S.Chand & Co. (2005)

Experiments (minimum four)

5. Fly wheel: Determination of frictional couple and moment of inertia of a flywheel.
6. Projectile Motion (computer simulation).
7. Cantilever: Determination of Young's modulus by vertical vibrations of a cantilever.

- 4) Torsional Pendulum: Determination of Rigidity Modulus of the material of a wire.
- 5) Jaeger's Method : Determination of Surface Tension.
- 6) Viscosity of a liquid by Poiseuille's method.
- 7) Bending of beams: determination of Young's modulus.
- 8: Capillarity: determination of Surface tension.

BSEDPHY102: ELECTRICITY

Circuit Analysis

Concept of constant current and constant voltage source, Maxwell's cyclic current method for circuit analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem (with proof).

Inductance

Self Inductance, self inductance of two parallel wires carrying equal current in opposite directions, Principle of non-inductive resistance coils, Self Inductance of co-axial cables, Mutual inductance, Coefficient of coupling, Inductance in series and parallel.

Response of circuits containing L C and R to DC (transients)

Growth and decay of current in L-R circuit, Charging and discharging of capacitor in C-R circuit and in a series L-C-R circuit.

Ballistic Galvanometer

General theory of a suspended coil ballistic galvanometer, Expression for charge, Figure of merit, Current sensitivity and voltage sensitivity.

A.C. Circuits

A.C. applied to L-R and C-R circuits, Inductive and Capacitive reactance, impedance and admittance, The j operator and vector or phasor method (including LR and LCR) A.C. applied to L-C-R circuits, Series and parallel resonance. Q factor and Bandwidth. Graphic representation of resonance (Variation of resistance, inductive reactance, capacitance reactance with frequency)

Mutually Coupled L-R circuits

A.C. applied to mutually coupled L-R circuits. Reflected impedance. Transformers, Effect of loading the secondary of a transformer.

A. C. Bridges

General A.C. bridge. Maxwell's bridge. Maxwell's L/C bridge. De-Sauty's capacitance bridge. Wein's frequency bridge.

Books

1. Fundamentals of Electricity and Magnetism. D. N. Vasudeva, S. Chand and Company Ltd. New Delhi (1995).

9) Electric Circuit and Theory. F. A. Benson and D. Harrison. E.L.B.S. (1995).

10) Electricity and Magnetism. J. Yarwood and J. H. Fewkes. University Tutorial Press (1991).

11) Electrical Technology, By Thereja

12) Electricity and Magnetism, Brijlal and Subramanian

13) Electrical Circuits : Schaum Series

Experiments (minimum four)

4) Verification of Thevenin's Theorem.

5) Verification of Norton's theorem.

6) Response of LR and CR circuits to A.C. - phasor diagrams.

7) Step Response of RC circuit / SLR Circuit.

8) L.D.R. Characteristics.

9) De Sauty's Bridge and Maxwells L/C Bridge.

10) LCR Series and parallel resonance –Resonant frequency, Q value and Bandwidth.

11) Resistance of Mirror Galvanometer / Table Galvanometer by Shunting.

12) Figure of Merit of Mirror Galvanometer and Determination of Current and Voltage Sensitivity.

10. Electrical Simulation of LR, CR, LCR Circuits : Computer Simulation by PSPICE / Electronics work bench.

Semester – II

BSEDPHY 201: WAVES AND ACOUSTICS

Waves and Oscillations

Periodic oscillations and potential well, differential equation for harmonic oscillator and its solutions (case of harmonic oscillations), kinetic and potential energy, examples of simple harmonic oscillations, spring and mass system, simple and compound pendulum, torsional pendulum, bifilar oscillations, Helmholtz resonator.

Superposition of two simple harmonic motions of the same frequency along the same line, interference, superposition of two mutually perpendicular simple harmonic vibrations of the same frequency, Lissajous figures, case of different frequencies.

Oscillatory Motion in a Resistive Medium:

Damped harmonic oscillator, Damped forced harmonic oscillator. Displacement and velocity, Resonance, Sharpness of resonance, Phase relationships, Energy consideration in a forced harmonic oscillator. Harmonic oscillator with an arbitrary applied force.

Sound

Velocity of longitudinal waves in fluids. Newton's formula for velocity of sound. Longitudinal vibrations in strings. Kundt's tube-determination of velocity of sound in a gas and in solids. Transverse vibrations in strings. Intensity level and Bel and Decibel. Production and detection of Ultrasonic waves and its applications.

Doppler effect. Source and listener in relative motion. (Normal incidence only)

Acoustics of Rooms and Musical Scales

Reverberation of Sound, Reverberation time, Absorption coefficient, Sabine's formula for reverberation time (discussions only) , Acoustic requirements of an auditorium.

Musical interval, harmony, melody. Diatonic scale. Tempered scale. (only concepts)

Books

1. Text book of Sound. D. R. Khanna and R.S. Bedi, Atma Ram, New Delhi (1994).
3. Sound. F. G. Mee, Heinemann Ltd., London (1967)
4. Text book of Vibration and Waves , Mac Millon (2002)

Experiments (minimum five)

15. Frequency of AC mains (Sonometer).
16. Helmholtz Resonator : Determination of unknown frequency.
17. Lissajous Figures (as a demonstration exp.).
18. Coupled Oscillations: resonance pendulum.
19. Flat Spiral Spring: determination of elastic constants by vertical and torsional oscillations of a loaded spring.
6. Calculation of reverberation Time & absorption Coefficient of room/hall (Numerical).
20. Angular Oscillations of a Bar – Bar Pendulum.
- 3) Wave superposition : Computer Simulation.

BSEDPHY 202: OPTICS**Refraction through the lenses**

Introduction to Lenses, optical properties of lenses, thin lenses & thick lenses, Cardinal points of an optical system, Co-axial system of two thin converging lenses. Aberrations Spherical & Chromatic aberrations in lenses (only conceptual), methods of minimizing Spherical & Chromatic Aberrations. Introduction to eyepieces, Ramsden and Huygens eyepieces (construction and their cardinal points)

Fundamentals of Reflection and Refraction

Refractive index and optical path, Fermat's Principle of least time, Derivation of the laws of reflection & refraction using Fermat's Principle.

Interference

Introduction, division of wavefront & division of amplitude.

Thin film Theory :- Formation of colors in thin film- reflected system, Transmitted system (only conceptual), wedge shaped film, Newton's Rings and its application to determine refractive index of liquid (Normal Incidence only)

Interferometry:- Michelson interferometer-its principle, working and its application to determine wavelength and difference between two wavelengths

Diffraction

Concept of Diffraction, Fresnel and Fraunhofer Diffraction, Division of cylindrical wave-front into half period strips, Fresnel's diffraction at straight edge (details) {Introduction of Chap 12 of B.K. Mathur, 12.3-12.5} Fresnel's diffraction at rectangular aperture and cylindrical wire

(conceptual). Fraunhofer diffraction at single slit and double slit (details), General N slit theory (Conceptual), Diffraction grating, width of principal maxima of plane diffraction grating. Resolving power of optical instruments:- Rayleigh's condition, Resolving power of telescope and grating.

Polarization

Concept of polarization, Plane of polarization, Polarization by reflection, Brewster's law, Polarization by refraction, Double refraction, uniaxial and biaxial crystals, Nicol's Prism,

Circularly and Elliptically polarized light - Theory and analysis, Retardation plates - Quarter wave plate and Half wave plate, Optical activity, specific rotation, simple Polarimeter, Laurent's half shade polarimeter.

Books

1. A text Book of Optics , N Subrahmayam and N. Brijlal, S. Chand & Company Ltd(1991)
2. Principles of Optics, B.K. Mathur, New Global Printing Press, Kanpur.
7. Optics, Ajoy Ghatak, Tata McGraw-Hill Publicashing Company Limited. (1977)
8. Fundamental of Optics, F.A. Jenkins and H.E. White, Tata McGraw-Hill Publishing Company Limited. (1981)
9. Contemporary Optics , Ghatak And Tyagrajan, Mc Millan 2003

Experiments (minimum five)

- * Wedge Shaped film / Newton's Rings.
- * Single Slit Diffraction.
- * Brewster's Law.
- * Diffraction Gratings.
- * Cardinal points of Two lenses.
- * Resolving Power of Telescope using Striped sheets.
- * Prism Spectrometer : Determination of Prism angle, minimum angle of deviation and dispersive power.
- * Optical Lever.

Semester – III

BSEDPHY 301: MECHANICS II

Motion under a central force:

Equivalent one body problem, general features of motion, qualitative discussions of orbits under inverse square law force field. Nature of orbits, elliptical orbits, Kepler's problem, hyperbolic orbits, classical scattering, definition of scattering cross section and angle of scattering,

Rutherford's scattering cross section and its derivations.

Motion of a system of particles:

Center of mass coordinates, conservation of linear momentum, angular momentum energy, Critique of conservation of laws, rockets, conveyor belts and planets. The collision problems, the two body problem.

Moving coordinate systems:

Moving origin of coordinate system, rotating coordinate systems, laws of motion on the rotating earth, qualitative description of Foucault's pendulum, and Larmor's theorem.

Rigid bodies, Rotation about an axis:

Rotation of an axis, Compound pendulum, equation of motion of a rigid body, calculation of centre of mass and moment of inertia.

Rotation of a rigid body:

Motion of a rigid body in space, Euler's equation of motion for a rigid body and qualitative discussion of motion of a symmetrical top.

Mechanics of continues media:

Equation of motion of a vibrating strings, normal modes of a vibrating string, wave propagation along a string. Kinematics of moving fluids, equation of continuity, equation of motion for an ideal fluid.

Books

8) Introduction to Classical Mechanics, R. G. Takawale and P. S. Puranik, Tata McGraw-Hill (1997)

9) Mechanics, K. R. Symon, Addison Wesley (1971)

Experiments (minimum five)

4. Kater's pendulum.
5. Double pendulum.
6. Bifilar suspension.
7. Log Decrement & Viscosity.
8. Study of motion of a top or a gyroscope.
5. Study of damping of a bar pendulum under various kinds of damping mechanics.
6. Numerical solution of equation of motion using a personal computer/calculator.
7. Motion of a particle in a central force field using numerical analysis and calculator/PC.

BSEDPHY 302: ELECTRONICS

Rectifiers and Regulators:

Volt-ampere characteristics of Junction diode, Half wave, Full wave and Bridge rectifiers using Junction diodes without and with capacitive filters. Percentage regulation, Ripple factor and Rectification efficiency. Zener diode characteristics and its use as a simple voltage regulator. Thermistor characteristics and its use in A.C. voltage regulation.

Transistors.

Basic configurations of transistors, Transistor characteristic in CE and CB mode, Current gains

Basic Amplifier Characteristics.

Current gain, Voltage gain, Power gain, Input resistance, Output resistance, Conversion efficiency, Classes of amplifier operations, Decibel, Frequency response, Amplifier bandwidth.

C-E amplifier: Class A.

Graphical analysis, Effect of adding A.C. load, Input and Output resistance, Conversion efficiency, Phase relationship between input and output.

Transistor Biasing.

Bias stability, Stability factor, Different methods of biasing, Biasing compensation.

Feedback.

Positive and negative feedback, Voltage and current feedback, series and shunt feedback.

Effect on negative feedback on gain, frequency response, input and output resistance and distortion. **Positive feedback**, Barkhausen criterion for oscillations, Phase shift oscillator, Wein bridge oscillator, LC tank circuit, Hartley oscillator and Colpitts oscillator.

Linear IC's and Operation Amplifiers.

The Differential Amplifier, OP-Amp characteristics, Input and Output impedance, Input bias and offset currents, Input and output offset voltages. Differential and Common mode gains, CMRR, Slew rate, OP-Amp as inverting, Non Inverting amplifier and Difference amplifier.

Text Books/ References:

3. Electronic Principles – A.P.Malvino TMH 5th edition 1996.
4. Electronics Devices and Circuits An Introduction- Allen Mottershed 3rd edition PHI 97
5. Intergrated electronics-Millman and Halkias TMH 1972
6. Basic Electronics and Linear Circuits-Bhargava, Kulshrestha and Gupta. TMH

5. Op-amp and Linear Intergrated Circuits- Ramakant Gayakwad PHI

Experiments. (minimum five).

8. Half wave and Full wave rectifier using Junction Diode, Load regulation characteristics.
9. Bridge rectifier with capacitor filter- Ripple factor using CRO.
10. OP-Amp: Characteristics Input and Output impedance.
11. OP-Amp: Inverting and Non-inverting amplifier.
12. Zener Diode Regulation.
13. Colpitts Oscillator./ Wein's Bridge Oscillator.
14. C.E. Amplifier. Gain v/s Load, Input and Output Impedance.
15. C.E. Amplifier. Fequency response with and without negative feedback. Calculation of Gain Bandwidth product.

Semester – IV

BSEDPHY 401: HEAT AND THERMODYNAMICS

Kinetic theory of gases.

Review of Kinetic Theory of gases, Average kinetic energy of a gas molecule. Degrees of freedom. Law of equipartition of energy and its application to specific heats of gases. Mean free path: Zeroth and first order approximation. Transport phenomena: transport of energy, momentum and matter. Brownian motion: Einstein's equation, Determination of Avogadro's number.

Behavior of real gases.

Deviation from a perfect gas behaviour. Discussion of results of Andrews Experiments on CO₂ and Amagat's experiment. Critical constants. Van der Waals' equation of state. Expression for Van der Waals' constants. Reduced equation of state. Relation between Boyle temperature and critical temperature.

Thermodynamics.

Zeroth and First law of Thermodynamics.

Basic concepts of thermodynamics: Thermodynamic system, Thermodynamic variables, Thermodynamic equilibrium, and Thermodynamic processes. Zeroth law of thermodynamics and concept of temperature. Internal energy and First law of thermodynamics. Relation between pressure, volume and temperature in adiabatic process. Work done in isothermal and adiabatic processes. Path dependence of heat and work.

Second law of Thermodynamics.

Reversible and irreversible processes. Carnot's cycle. Second law of thermodynamics. Efficiency of heat engines. Carnot's theorem. Latent heat equations.

Thermodynamic scale of temperature, its identity with perfect gas scale.

Entropy.

Entropy as a Thermodynamic variable. Entropy change in reversible and irreversible processes. Temperature - Entropy diagram of Carnot's cycle. Entropy of a perfect gas. Entropy of a mixture of gases. Physical significance of Entropy: Entropy and Unavailable Energy, Entropy and molecular disorder. Entropy and Second Law of Thermodynamics. Impossibility of attaining Absolute Zero (Third law of Thermodynamics) Maxwell's Thermodynamic Relations and its applications.

Text Books/References

1. Treatise on heat - M.N. Saha and B.N. Shrivastava, The Indian Press(1965)
2. Thermal Physics – S.C . Garg, R.M. Bansal and C. K. Ghosh, TMH (1993)
3. Thermodynamics – J.K. Roberts and A.R Miller , E.L.B.S. (1960)
4. Text Book of Heat – G.R. Noakes, Mcmilan & Co(1960)
5. Thermodynamics - William C .Reynolds (1968)
6. Heat and Thermodynamics – M.W. Zemansky and R.H. Dittman, McGraw Hill (1997)

Experiments (minimum five)

6. Resistance Thermometry.
7. Constant volume and constant pressure air thermometers.
8. Thermistor characteristics.
9. Study of thermocouples for temperature measurements.
10. Study of Brownian motion.
11. Measurement of thermal conductivity of poor conductors.
12. Stefans Constant.
13. Calibration of Si diode as a temperature sensor

BSEDPHY 402: MODERN PHYSICS

Electrons, Nucleus and Atoms:

Electric discharge through gases, Determination of e/m for cathode rays, Charge and mass of an electron, Rutherford's theory of nuclear of the atom, Qualitative discussion of alpha scattering experiment, Atomic masses, Energy and mass units.

Brief review of Atomic models:

Review of Bohr's Hydrogen atom, Frank-Hertz experiment and atomic energy levels, Bohr-Sommerfeld model-attempt to explain fine structure, Finite nuclear mass model. Isotope effect – variation of Rydberg constant for different isotopes, Bohr's correspondence principle.

Atomic Physics:

Measurement of Mass: Thomson's positive ray analysis, Dempster's Mass spectrometer, Bainbridge Mass spectrograph.

Particle Accelerators:

Linear accelerator and Cyclotron.

Crystal Structure:

Crystal lattice, crystal planes and Miller indices, unit cells, typical crystal structures.

X-rays:

Coolidge tube generator, Continuous X-ray spectra and its dependence on voltage, Duane and Hunt's law, Wave nature of X-rays – Laue's pattern, Diffraction of X-rays by crystal Bragg's law, Bragg single crystal spectrometer Analysis of crystal structure - simple cubic crystal.

Properties of electromagnetic radiation:

Qualitative discussion of Radiation from an accelerated charges, Brief review of the light phenomenon that demonstrates wave nature, Black Body Radiation, Photoelectric effect and Compton effect – observation, description, derivations of relevant equations and failure of classical physics to explain the same. Experimental verification of the Photoelectric effect by Millikan and Compton effect.

LASERS:

Purity of a spectral line, Coherence length and coherence time, Spatial coherence, Eienstein's A and B coefficients, Qualitative discussion of population inversion, spontaneous emission, stimulated emission, Ruby lasers, He-Ne laser, semiconductor laser, Carbon dioxide laser,

Pulsed Nitrogen, Applications of lasers in Medicine, Industry and Science. Holography: Construction of holograms, Principle and application.

Optical fibres: Basic principle, Optical fiber communication, Losses in Optical fibres.

Text Books:

1.Perspectives of Modern Physics, Arthur Beiser, 5th Edition, McGraw Hill (1995).

4) H.Semat and J.R.Albright, Introduction to Atomic and nuclear Physics, V

Edition, Chapman and Hall

5) J.B.Rajam, Atomic Physics, S.Chand and Company Ltd.

4. Introduction to Modern Physics, F.K. Richtmyer, E.H.Kennard, J.N. Cooper (6th Ed.)

g) Optics, A. Ghatak, Tata McGraw-Hill, 2nd Edition (1993).

h) Laser: Theory and Applications, K. Thyagrajan and A. Ghatak McMillan (1987)

i) Optical Electronics, K.Thyagarajan and A.Ghatak, Cambridge University Press (1997)

j) LASERs and Non-linear optics, B.B.Laud, Wiley Eastern (1985)

Experiments (minimum five)

1)Laser based experiment.

2)Laser based experiment (with one kit several experiments can be done, only two are suggested assuming one kit per college and two sets of experiments in the semester).

3)X-ray emission (characteristic lines of copper target) – calculation of wavelength and energy and assigning transitions.

4)Calculation of lattice constant by of Copper – x-ray diffraction pattern is given and student calculates, d-spacing, miller indices and lattice constant.

5)Frank Hertz Experiment.

6)Characteristics of photo cell.

7)Measurement of Boltzmann constant using transistor.

8)Photocell (verification of Photoelectric effect)

9)e/m using cathode ray tube.

Semester V

BSEDPHY 501: ELECTRONICS

Analog Electronics:

Transistors Multivibrators.

Transistor as a switch, switching times, Multivibrators – Astable, Monostable, Bistable and Schmitt Trigger.

Field Effect Transistors.

Basic structure of the JFET, Principles of operation, Characteristic curves and parameters, Common source amplifiers, Common gate amplifier (only qualitative discussion), The MOSFET Depletion Mode and Enhancement mode, Dual-Gate MOSFET. FET Phase shift oscillator, FET as VVR and its applications in Attenuator, AGC and Voltmeter circuits.

Applications of OP-AMP.

Active diode circuits, Integrator, Differentiator, Comparator, Window comparator, Schmitt Trigger, Waveform generator –Square wave, Triangular and Ramp Generator and monostable.

Timers:

The 555 Timer, Basic concept, 555 block diagram, Monostable, Astable, Bistable, Schmitt Trigger and Voltage controlled oscillator (VCO) using 555 timer.

Digital Electronics:**Number system Logic.**

Binary number system, Binary to Decimal and Decimal to Binary conversion, Basic logic gates, OR, AND, NOR, NAND, and EX-OR gates. De Morgan's Law's, Boolean Algebra, NAND and NOR gates as universal building blocks in logic circuits, Sum of Products methods and Product of Sum methods of representation of logical functions. Half adder and Full adder, Multiplexer and Demultiplexer.

Logic families – DTL, TTL Standard TTL NAND gate, Schottky TTL, ECL OR and NOR gate, MOS (inverter, NAND and NOR gates) and CMOS (inverter, NAND and NOR gates).

Flip Flops and Counters.

Basic RS FF, Clocked RS FF, JK FF, D-type and T-type FF, Master Slave Concept, Shift register (shift left, shift right) Schmitt trigger, Applications of FF's in counters, binary ripple counter, Modulus of counter (3,5) BCD Decade Counter, Cascade BCD Decade counters, Principle of digital counter digital voltmeter, and digital clock. Encoders and decoders

Text Books/ References:

1. Electronic Principles: A.P. Malvino TMH 5th edition 1996.
2. Digital Principles and Applications: Malvino and Leach TMH 4th edition 1986.
3. Electronics Devices and Circuits An Introduction: Allen Mottershed PHI 1997
4. Intergrated Electronics: Millman and Halkias TMH 1972
5. Electronic Devices and Circuits: Millman and Halkais Mc Graw Hill 1967
6. Modern Digital Electronics: R. P. Jain TMH 3rd edition 2003.
7. Principles of Electronics: V.K.Metha S.Chand & Company 8th edition 2003.

BSEDPHY 502: WAVE MECHANICS**Wave and particles:**

De Broglie's hypothesis, Review of the Bohr's postulate about stationary states in the light of De Broglie's hypothesis, The concept of quantum (particle) nature of radiation.

Demonstration of wave nature of particles-Davisson Germer experiment, electron diffraction experiment of G.P.Thomson, Dual nature of radiation/matter. Complimentary in Duality.

The Wave Function:

Representation of a De Broglie wave, Velocity of De Broglie wave, Construction of a wave group, Wave packet and its motion in one dimension., Group velocity and particle velocity, Max Born's interpretation of the wave function, probability concept, Acceptable wave function, Normalization of wave function.

Heisenberg's Uncertainty Principle:

Limitation of wave mechanics to predict the physical state of a particle/system accurately. Derivation of Heisenberg Uncertainty principle relation for p and x , E and t . Illustration by thought experiments (-ray microscope, single slit diffraction and double slit experiment), Applications of Heisenberg Uncertainty principle.

Schroedinger's Wave Equation:

Derivation of the wave equation on a stretched string, Derivation of Schroedinger's time dependent wave equation, Postulates of Quantum mechanics, Extraction of information from solutions in terms of expectation values of physical variables/observable. Definition of operators & their necessity, Eigen value equation, Commutation relations, Expression for expectation values of momentum and energy in terms of operators. Operators as fundamental postulates of wave mechanics and establishment of Schroedinger's time dependent equation. Concept of stationary states. Schroedinger's time independent equation.

Application of Schrodinger's Steady State Equation:

1) Free particle 2) One-dimensional infinite square well potential: Energy eigen functions and eigen values. Show how probability distribution changes as the quantum number m . Calculation of $\langle x \rangle$ and $\langle p_x \rangle$. 3) Particle in one and three dimensional box, Concept of degeneracy 4) One dimensional finite square well potential placed symmetric to origin, Energy eigen values and functions. Parity and parity operators. 5) One dimensional finite square step potential of height V_0 : Comparison of classical and quantum mechanical results for particle energy $E > V_0$ and $E < V_0$. 6) Rectangular potential barrier and penetration through it, tunnel effect, Qualitative discussion of alpha decay, tunnel diode & scanning tunneling microscope. 7) Harmonic Oscillator- One dimensional, Energy Eigen value and energy eigen functions, Zero point energy and its significance.

Books:

1. Perspectives of Modern Physics, Arthur Beiser, 5th Edition, McGraw Hill (1995)
2. Introduction to Modern Physics, F.K. Richtmayer, E.H. Kennard, J.N. Cooper (6th Ed.)
3. Introduction to Atomic Physics, H.E. White, H. Semat and J.R. Albright,
4. Introduction to Atomic and nuclear Physics, V Edition, Chapman and Hall
5. Introduction to Quantum Mechanics, P.T. Matthews, TATA McGRAW-HILL Pub. Ltd.
6. Quantum Mechanics, Theory and Applications; Ghatak and Lokanathan.

BSEDPHY 503: NUCLEAR PHYSICS**Properties of the Nucleus:**

Basic Properties of the nucleus, Mass/size (radius), Nuclear spin, Magnetic dipole moment, Electric Quadrupole moment, Parity. Packing fraction, Binding energy, B.E versus A plot, Saturation of nuclear forces.

Nuclear forces:

Main characteristics of Nuclear Forces. Meson theory of Nuclear forces, Estimation of the mass of a meson using Heidelberg's Uncertainty Principle, Yukawa potential.

Radioactivity:

The law of Radioactivity Decay, Mean life, Half life & Decay constant. Successive radioactive transformation (A-B-C) type, Ideal transient & secular equilibrium. Radioactive series, Carbon dating, artificial radioactivity.

Radioactive decay:

Alpha decay, Velocity and energy of alpha particles, Geiger-Nuttall law, alpha spectra and fine structure, short range and long range alpha particles, disintegration energy, Gamow's theory of alpha decay. (Qualitative treatment)

Beta Decay: Types of Beta decay, Energies of (Beta -decay, The continuous beta particle spectrum & difficulties in understanding it, Pauli's neutrino hypothesis, Fermi's theory of Beta decay, (Qualitative treatment,) K-capture. Gamma Decay : Origin of gamma decay, Internal Conversion, Nuclear isomerism.

Nuclear models:

Liquid drop model of a nucleus. The Compound Nucleus theory, Analogy between liquid drop & a nucleus. Weizsacker's semi empirical mass formula.

Mass Parabolas, Prediction of stability against β -decay for members of a isobaric family, Spontaneous & induced fission, Bohr – Wheeler theory for nuclear fission and the condition for spontaneous fission on the basis of Z/A . Symmetric fission from the semi-empirical formula.

Nuclear Shell Model:

Experimental evidence for magic numbers. Evidences that lead to shell model, Main assumption of the single particle shell model, Jensen-Mayer Scheme (No derivation), Predictions of the shell model.

Nuclear Energy:

Neutron induced fission, Mass yield in an asymmetrical fission, Energy released in the fission of U-235. Fission chain reaction, Principle of a nuclear reactor, Neutron cycle in a thermal nuclear reactor (The four factor formula), Principle of a breeder reactor.

Detection of Nuclear Radiation:

Ionization chamber, Proportional counter, Geiger Muller counter, Photographic Emulsions.

Text Books / References:

1. Nuclear Physics, Irving Kaplan, Narosa Publishing House
2. Perspectives of Modern Physics, Arthur Beiser, 5th Edition, McGraw Hill (1995)
3. Introduction to Modern Physics, F.K. Richtmyer, E.H. Kennard, J.N. Cooper (6th Ed.) McGraw Hill (1997).

Semester VI

BSEDPHY 601: ELECTROMAGNETIC THEORY-I

Vector Calculus

Vector Algebra (brief revision of basic vector operations)

Vector Differentiation :- scalar fields, vector fields , the time derivative, del operator, Gradient of a scalar function, Divergence, curl and Laplacian operator with physical significance.

Integration of vector Functions :- Line integrals, surface integrals, volume integrals

Divergence Theorem due to Gauss, Curl Theorem due to Stoke's ,Green's Theorem (all theorems with proof). Differential vector Identities with proof. [\[Harper\]](#)

Electrostatics

Coulomb's Law, Electric Field, Continuous charge distribution, field lines, flux, and Gauss' law with applications [\[Griffiths\]](#) , the electric dipole , multipole expansion of electric fields[\[Reitz and Milford\]](#), The Dirac Delta function [\[Griffiths\]](#).

Techniques to solve electrostatic problems

The electrostatic potential, Poisson's equation, Laplace's equation in one independent variable, solutions to Laplace's equation in spherical co-ordinates (zonal harmonics), conducting sphere in a uniform electric field, electrostatic images, point charge and conducting sphere. [\[Reitz\]](#)

Electric Fields in matter

Polarization, Fields outside of a dielectric dielectric medium, electric field inside a dielectric , Gauss's law in a dielectric, the electric displacement vector, electric susceptibility and dielectric constant. Boundary conditions on the field vectors , Boundary value problems involving dielectric, Dielectric sphere in a uniform electric field.[\[Reitz\]](#)

Microscopic Theory of Dielectrics

Molecular field in a dielectric induced dipoles , A simple model, polar molecules, Langevin's Debye formula , permanent polarization, ferroelectricity. [\[Reitz\]](#)

Work and Energy in electrostatics

The work done to move a charge, the energy of a point charge distribution, the energy of continuous charge distribution, Energy density of an electric field. Basic properties of conductors, Induced charges, capacitors. [\[Griffiths,Reitz\]](#)

BOOKS :-

1. Introduction to Mathematical Physics, Charlie Harper,

Introduction to Electrodynamics , David Griffiths, Prentice Hall of India Ltd, New Delhi
(1995)

1) Foundations of Electromagnetic Theory , Reitz and Milford , Addison-Wesley Publishing
Company.

Electricity and Magnetism, Mahajan and Rangawala , Tata McGraw-Hill Publishing Company
Ltd.

Electricity and Magnetism; Rakshit and Chatopadhyaya

BSEDPHY 602: PRACTICAL PAPER I [Experiments. (Minimum eight)]

Section I

1. Study and analysis transistorised Multivibrators- Astable, Monostable.
2. Study and analysis transistorised Multivibrators- Bistable, Schmitt trigger.
3. F.E.T Characteristics.
4. F.E.T Common Source Amplifier.
5. OP-amp as a differential amplifier and its application in temperature measurement.
6. Regulated power supply using IC LM 317 with external pass transistor.

Section II

7. Study of IC 555 as Astable, and its use as Voltage Controlled Oscillator.
8. Study of Timer as a mono-stable multivibrator.
9. Analog Multiplexer.
10. Digital Multiplexer.
11. Verification of De Morgan Law's and Boolean Identities. (Construction using Gates)
12. NAND and NOR gates as universal building blocks.
13. Binary addition- Half adder and Full adder using any gates.
14. Study of JK flip flop with JK FF IC's (Ripple counter and Decade counter).

N. B.: Course instructor is advised to conduct 4 experiments from each Section.

BSEDPHY 603: PRACTICAL PAPER II [Experiments. (Minimum eight)].

Section I

1. Specific heat of graphite.
2. Resolving power of grating.
3. Resolving power of Prism.
4. Fraunhofer diffraction at double slit.

5. Lloyd's mirror.
6. Absorption spectrum of a liquid (KI).

Section II

7. Polarimeter.
8. Transient response of L-C-R circuit using square wave generator and C.R.O.
9. Core losses and copper losses in a transformer.
10. Measurement of Dielectric constant of a liquid by capacitance method.
11. Susceptibility measurement by immersing a parallel plate capacitor in a dielectric Medium/ for disk capacitor as a function of temperature.
12. Capacitance of two co-axial metal tubes.
13. E and D field measurement for parallel plate capacitor and calculation of dielectric constant.

N. B.: Course instructor is advised to conduct 4 experiments from each Section.

SKILL BASED PAPERS

BSEDPHY SK 604: ELECTRICAL AND ELECTRONIC INSTRUMENTATION

DC indicating Instruments:

PMMC Galvanometer (D' Arsonal Movement) – Principle, Construction and working –Current Sensitivity, Voltage Sensitivity & Megohm Sensitivity – Advantages and Disadvantages – Conversion of Galvanometer in to ammeter, Voltmeter and Ohmmeter (Series and Shunt Types).

AC indicating Instruments:

Electrodynamometer- Principle, Construction and working- Merits and Demerits- Rectifier Type Instruments- Thermocouple Instruments (Contact & Non – contact types)-Electrostatic Voltmeters- Principle, Construction and Working – Watt – hour Meter.

DC Bridges:

Wheatstone bridge – Determination of resistance- Kelvin double Bridge- Determination of resistance. AC Bridges: Maxwell's Bridge – Determination of self –Inductance – Wien's Bridge- Determination of frequency – Schering's Bridge- Determination of Capacitance.

Power Supplies:

Unregulated D.C. (full wave, bridge rectifier) power supplies. C- Filter and LC filter, Regulated power supplies, fixed voltage regulator, SMPS power supplies.

Oscilloscopes:

Block Diagram – Deflection Sensitivity – Electrostatic Deflection – Electrostatic Focusing – CRT Screen – Measurement of Waveform Frequency, Phase difference and time intervals – Sampling Oscilloscope- Storage Oscilloscopes.

Instrumentation Amplifiers and Signal Analyser:

Instrumentation amplifier, Electronic Voltmeter, Electronic Multimeter- Digital Voltmeter-Ohm meter- Function Generator ,Wave analyser- Fundamentals of Spectrum Analyser.

Practicals:

1. Unregulated power supply with C- filter.
2. Regulated power supply.
 - i) Fixed voltage regulated power supply.
 - ii) Standard low voltage SMPS power supply.

Books for study and Reference

1. Electronic Instrumentation and measurement Techniques- W.D. Cooper 7 A.D. Helfrik, Plentice Hall of India.
2. A course in Electrical and Electronic Measurements and Instrumentation – A.K. Sawhney, Dhanpat Rai and Sons.
3. Electronic Instrumentation & Measurements- P.B. Zbar, Mc. Graw Hill International.

BSEDPHY SK 605: COMPUTATIONAL PHYSICS

C Language Fundamentals:

Constants, Variables, Keywords, rules for constructing integer constants, real constants, character constants. Types of C variables and rules for constructing variable names. Declaration instruction, arithmetic instruction, Integer and float conversion, type conversions in assignments, hierarchy of operation and associativity of operators.

Decision Structure:

if statement, if-else, nested if-else. The logical operator: the if-else clause, the not operator, conditional operator.

Loop Control Structure:

while loop, for loop, nesting of loop, multiple initializations in the for loop. The break statement, the continue statement and the do-while loop.

The Case Control Statement:

Using switch statement. Functions & Pointers: definition of function, why use functions?, passing values between function, scope rule of functions, calling convention. Advanced features of functions: return type of function, call by value and call by reference. Introduction to pointers, pointer notation, recursion and stack. Adding function to library.

Programming :

Simple pendulum, Bar pendulum, Project motion, surface tension, logarithmic decrement, Nuclear decay, Wave motion, specific heat, Magnetic field in a straight wire, Diffusion equation, Ohms law, Kirchhoff's Rules, Network theorems, Boolean laws, Heat transfer & Kepler's Laws. Solution of first order differential equation. Solution of linear equation. Use of spread sheets for plotting graphs.

Reference Books:

1. An Introductory Course in Computational Physics-Richard Fitzpatrick.
2. Computational Physics-Nicholas Giordano & Hisao Nakanishi.
3. Introduction to computational Physics-Tao Pang.
4. Let Us C- Yashwant Kanetkar (8th edition) BPB Publishers

SEMESTER VII**BSEDPHY 701: SOLID STATE DEVICES AND INSTRUMENTATION****Solid State Devices:****Two Terminal Devices.**

Tunnel diodes, Power diodes, Varicap diodes, Schottky Barrier diode, Semiconductor photoconductive cell, Photovoltaic cell, Photodiode, Light emitting diodes (LED), Liquid Crystal display (LCD), Solar cells and Photocouplers.

(Book: Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky. Chapter 1.13 to 1.22) Book – Electronic Principles – Malvino Chapter 7.14

Industrial Devices.

Silicon controlled rectifier (SCR), SCR characteristics, rating, construction and terminal identification, SCR applications, Silicon controlled switch (SCS), Gate turn off switch (GTO), Light activated SCR (LASCR), Shockley diode, Diac, Triac, Typical Diac-Triac Phase control circuit, Unijunction transistor (UJT). Phototransistor, V-FET.

(Book: Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky.

Chapter 9.1 to 9.15, 14.9) Book – Mottershead – Chapter 28.4

Image Capture Devices.

Vidicon tube, Plumbicon, Silicon Diode Array Vidicon, Solid State Image scanners (CCD's).

(Book: Monochrome and Colour TV, R.R. Gulati).

Instrumentation:**Measuring Instruments.**

Analog DC ammeter, Multirange ammeter, Universal shunt, AC & DC voltmeter, Multirange voltmeter, Extending voltmeter range, Transistor voltmeter, Ohmmeter – Series and shunt type, Multimeter, Digital voltmeter, multimeter and frequency meter, Q meter.

(Book: Kalsi Electronic Instrumentation. Chapter 3.1 to 3.3, 4.2 to 4.7, 4.21, 4.22, 5.2, 6.2,6.3,10.7)

Oscilloscope:

CRT, CRO block diagram (simple CRO), Vertical amplifier, horizontal deflection system, sweep generator, Delay line.

(Book: Kalsi Electronic Instrumentation. Chapter 7.2.1, 7.4, 7.5, 7.5.1,7.6,7.7.1,7.10)

Transducers:

Introduction, Electrical transducer, selecting a transducer, Strain gauges, resistance wire gauge, type of strain gauge, foil strain gauge, semiconductor strain gauge, Thermistor, Inductor transducer, LVDT, Capacitive transducer, Piezo electric transducer and Hall effect transducers.

(Book: Kalsi Electronic Instrumentation. Chapter 13.1 to 13.3, 13.6, 13.6.1 to13.6.4, 13.6.8,13.9,13.9.1,13.11,13.13)

Signal Generator:

Standard signal generator, AF sine and square wave generator, function generator.

(Book: Kalsi Electronic Instrumentation. Chapter 8.4,8.5,8.7,8.8)

Books/References

1. Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky.
2. Monochrome and Colour TV, R.R. Gulati).
3. Electronic Instrumentation: Kalsi TMH
4. Electronic Devices and Circuits: J. Millman and C. Halkias
5. Electronic Instrumentation and Measurement Techniques: William David Cooper PHI 3rd edition
5. Electronics Devices and Circuits An Introduction: Allen Mottershed PHI 3rd edition Electronic Principles – Malvino
6. A course in Electrical and Electronic Measurement: A. K. Sawhney Dhanpat Rai and Com. 2001.

BSEDPHY 702: ATOMIC AND MOLECULAR PHYSICS**Hydrogen Atom:**

Schrodinger's equation for the H-atom, separation of variables, Quantum numbers-n, l, ml, spin, magnetic moment, J and mJ, Angular momentum, Magnetic moment and Bohr magneton.

Many Electron Atoms:

Pauli exclusion principle and classification of elements in periodic table. Symmetric and Antisymmetric wave functions, Electron configuration, Hund's rule, Spin orbit interaction,

Vector atom model, Total angular momentum, L-S coupling, J-J coupling.

Atomic Spectra:

Spectroscopic rotation, Selection rules (derivation from transition probabilities), Alkali metal type spectra, Principal, Sharp, Diffused and Fundamental series, fine structure in alkali spectra.

Atoms in a Magnetic Field:

Effects of magnetic field on an atom, Larmor Precession, The Normal Zeeman effect, Lande 'g' factor, Zeeman pattern in a weak field (Anomalous Zeeman effect), The Stern-Gerlach experiment.

X-ray Spectra:

Characteristic spectrum, Moseley's law, Explanation of X-ray spectra on the basis of quantum mechanics, Energy levels and characteristic X-ray lines, X-ray absorption spectra, Fluorescence and Auger effect.

Spectra of Diatomic Molecules:

Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibration-Rotation spectra, Fortrat Parabolas and explanation of band structure on its basis, Electronic spectra

.

Raman Effect:

Quantum theory of Raman effect, Classical theory of Raman effect Pure rotational Raman spectra, Vibrational Raman spectra, Rotational fine structure, Experimental set up for Raman effect.

References:

1. Perspectives of Modern Physics, Arthur Beiser, 5th Edition, McGraw Hill (1995)
2. Introduction to Modern Physics, F.K. Richtmyer, E.H. Kennard, J.N. Cooper (6th Ed.)
1. Introduction to Atomic Spectra, H.E. White, McGraw Hill Book Company
2. Introduction to Molecular Physics, Barrow
3. Spectrophysics, Anne P. Thorne, Chapman and Hall

BSEDPHY 703: THERMODYNAMICS AND STATISTICAL MECHANICS

Thermodynamics:

Power cycles.

Internal Combustion Engines – The Otto cycle and its efficiency. Diesel cycle and its efficiency. Mean effective pressure in Carnot, Otto and Diesel cycles.

Production of low temperature.

Cooling by evaporation. Vapour compression machines. Refrigerators based on Vapour absorption. Cooling by sudden adiabatic expansion of compressed gases. Efficiency and performance of Refrigerating machines. Enthalpy and heat flow. Joule Kelvin effect. Expression for Joule Kelvin coefficient and inversion temperature. Application to Van der Waals' gas.

Principles of regenerative and cascade cooling. Liquifaction of hydrogen and helium. Production of temperatures below 4°K . Properties of He I and He II. Cooling by Adiabatic Demagnetisation of paramagnetic substances.

Statistical Mechanics:

Probability

Random Events, Probability, Probability and Frequency, Some basic rules of Probability theory, Continuous random variables, Mean value of discrete and continuous variables, Variance: Dispersion, Probability Distribution, Binomial distribution: Mean value and fluctuation, Stirling's Approximation, Poisson Distribution: Mean value and Standard deviation, Gaussian Distribution: Standard deviation, Random Walk,

Maxwell-Boltzmann Distribution

The most probable distribution. Maxwell Boltzmann Statistics. Molecular speeds: mean, most probable and rms speeds. Experimental verification of Maxwell Boltzmann statistics. Probability and Entropy. Statistical interpretation of second law of Thermodynamics. Other statistical distributions (Bose Einstein and Fermi Dirac statistics: Only qualitative study) Phase Space.

Text Books/References

1. Thermodynamics and Statistical physics – D.P Khandelwal and A.K. Pande, Himalaya Publishing House
2. Introduction to Statistical Mechanics – B.B. Laud, New Age International (2003)
3. Treatise on heat - M.N. Saha and B.N. Shrivastava, The Indian Press (1965)

1. Thermal Physics – S.C Garg, R.M. Bansal and C. K. Ghosh, TMH (1993)
2. Thermodynamics – J.K. Roberts and A.R Miller , E.L.B.S. (1960)
3. Text Book of Heat – G.R. Noakes, Mcmilan & Co (1960)
4. Thermodynamics - William C .Reynolds (1968)
5. Heat and Thermodynamics – M.W. Zemansky and R.H. Ditman, McGraw Hill (1997)
6. Perspectives of modern physics – Arthur Beiser, 5th edition, McGraw hill (1995)

Semester VIII **BSEDPHY 801:ELECTROMAGNETIC THEORY (II)**

Magnetostatics and Relativity

Magnetic Field of Steady Currents

Biot-savart's law and its applications, Ampere's circuital law, magnetic vector potential, magnetic field of a distant circuit, magnetic scalar potential.[\[Reitz\]](#)

Magnetic Field in material media

Magnetization, magnetic field produced by magnetized material, magnetic scalar potential and magnetic pole density, sources of the magnetic field, magnetic intensity, The field equations, magnetic susceptibility and permeability, Hysteresis, Boundary conditions on the field vectors [\[Reitz\]](#), current circuits containing magnetic media, Magnetic circuits[\[Mahajan,Rangawala\]](#), Magnetic circuits containing permanent magnets.

Microscopic Theory of Magnetism

Molecular field inside matter, Origin of Diamagnetism, Origin of Paramagnetism, theory of Ferromagnetism , Ferromagnetic domains.[\[Reitz,Griffiths\]](#)

Magnetic Energy

Magnetic energy of coupled circuits, Energy density in the magnetic field, Hysteris Loss.[\[Reitz\]](#)

Maxwell's Equations

Faraday's Law of electromagnetic induction, Generalization of Ampere's Law, Displacement current, Maxwell's equations and their empirical basis, Electromagnetic energy.[\[Reitz,Griffiths\]](#)

Relativity

Michelson-Morley experiment, postulates of the theory of special Relativity.

Relativistic Kinematics

Relativity of simultaneity, Derivation of Lorentz transformation equations, some consequences of Lorentz transformation equations, Relativistic addition of velocities, relativistic transformation of velocities and Doppler effect in Relativity .

Relativistic Mechanics

Mechanics and Relativity, Redefining momentum, Relativistic momentum, Relativistic mass, Equivalence of mass and energy.

Reference Books : -

- Introduction to Mathematical Physics , Charlie Harper,
 - Introduction to Electrodynamics, David Griffiths, Prentice Hall of India Ltd, New Delhi (1995)
 - Foundations of Electromagnetic Theory, Reitz and Milford, Addison-Wesley Publishing Company.
4. Electricity and Magnetism, Mahajan and Rangawala, Tata McGraw-Hill, Publishing Company Ltd.

BSEDPHY 802: PRACTICAL PAPER I [Experiments. (Minimum eight)]

Section I

- ☐ Energy band gap of a semiconductor .
- ☐ Light emitting diode VI characteristics and dynamic range.
- ☐ Photodiode/ Phototransistor: Variation of current with Intensity (distance) and with wavelength.
- ☐ UJT characteristics and its use in relaxation oscillator.
- ☐ SCR characteristics and gate controlled ac half wave rectifier.
- ☐ DIAC and TRIAC Characteristics, Gate triggering application.

Section II

- Design of Simple Square / sine wave oscillator. Using XR 2206/ NE 566/ LM 8038
- Construction and design of analog two ranges voltmeter.
- Crystal Oscillator: Determination of velocity of ultrasonic waves in a liquid medium .
- Determination of transition capacitance of Varactor diode as function of reverse bias voltage and use as a variable/tuning capacitor in any one application. (type CD91 or

Bel 90 or equivalent).

- Study of strain Gauges
- Study of LVDT (including calibration) and its use in any one application.

N. B.: Course instructor is advised to conduct 4 experiments from each Section.

BSEDPHY 803: PRACTICAL PAPER II [Experiments minimum eight]

Section I

- a) Velocity of sound by forming stationary waves by using C.R.O.
 - b) Cylindrical obstacle.
 - c) Double refraction.
 - d) Searle's Goniometer.
 - e) Biprism.
- Hysteresis by magnetometer.

Section II

7. Measurement of Hysteresis loss using CRO.
8. Michelson Morley Experiment.
9. Absolute capacity by ballistic galvanometer.
10. Mutual inductance by ballistic galvanometer.
11. Variation of mass with velocity. (Computer Simulation)
12. C1/C2 by ballistic galvanometer De Sauty's Method.
13. Measurement of emissivity of hot bodies, (various types of surfaces)

N.B.: Course instructor is advised to conduct 4 experiments from each Section.

PAPER VII: PHYSICS PROJECT:

Project title is expected to be finalized at the beginning of the fifth semester to be completed at the end of six semesters. Project should consist of either development / simulation of Physics Systems beyond the scope of practical syllabus wherein students have scope to understand, analyze and have hands on training in the field of Physics. The project may be undertaken in association with local industries.

B.Sc.B.Ed. CHEMISTRY

Purpose of the Course

- 1) To cater to the demands of chemical industries of well trained graduates.
- 2) To build confidence in the candidates to be able to work on their own in industries.
- 3) To develop an independent & responsible work ethics.
- 4) To train students for Higher education.

Scope & Opportunities



Chemical Industries



Other industries in supervisory posts



Production & Sales



Higher studies



Teaching



Laboratory assistant

SEMESTER- I: BSEDCEM 101: PHYSICAL & INORGANIC CHEMISTRY

BSEDCEM 103: ORGANIC & INORGANIC CHEMISTRY

SEMESTER- II: BSEDCEM 102: PHYSICAL & INORGANIC

CHEMISTRY

BSEDCEM 104: ORGANIC & INORGANIC CHEMISTRY

SEMESTER- III: BSEDCEM 201: PHYSICAL & INORGANIC CHEMISTRY

BSEDCEM 203: ORGANIC & INORGANIC CHEMISTRY

SEMESTER- IV: BSEDCEM 202: PHYSICAL AND INORGANIC CHEMISTRY

BSEDCEM 204: ORGANIC AND INORGANIC

CHEMISTRY SEMESTER- V: BSEDCEM 311: PHYSICAL CHEMISTRY

BSEDCEM 321: INORGANIC CHEMISTRY

BSEDCEM 331: ORGANIC CHEMISTRY

BSEDCEM 341: ANALYTICAL CHEMISTRY* OR

BSEDCEM 351: ENVIRONMENTAL CHEMISTRY* OR

BSEDCEM 361: PHARMACEUTICAL CHEMISTRY*

Lab. Courses: BSEDCEM 301: EXPERIMENTS IN PHYSICAL AND ANALYTICAL CHEMISTRY

BSEDCEM 303: EXPERIMENTS IN INORGANIC AND ORGANIC CHEMISTRY

SEMESTER- VI: BSEDCEM 312: PHYSICAL CHEMISTRY

BSEDCEM 322: INORGANIC CHEMISTRY

BSEDCEM 332: ORGANIC CHEMISTRY

BSEDCEM 342: ANALYTICAL CHEMISTRY* OR

BSEDCEM 352: ENVIRONMENTAL CHEMISTRY* OR

BSEDCEM 362: PHARMACEUTICAL CHEMISTRY*

Lab. Courses: BSEDCEM 302: EXPERIMENTS IN PHYSICAL AND ANALYTICAL CHEMISTRY

BSEDCEM 304: EXPERIMENTS IN INORGANIC AND ORGANIC CHEMISTRY :PROJECT

**Available in only selected colleges*

SEMESTER – I: COURSES BSEDCEM 101 AND BSEDCEM 103

SEMESTER – II: COURSES BSEDCEM 102 AND BSEDCEM104

SEMESTER – I

BSEDCEM 101 : Physical & Inorganic Chemistry

Section - I (Physical Chemistry)

I Mathematical Concepts

Logarithmic relations, curve sketching, linear graphs and calculations of slopes differentiation of functions like Kx , e^x , x^n , $\sin x$, $\log x$, maxima & minima, partial, differentiation & reciprocity relations. Integration of some useful/relevant functions

II Gaseous State

Postulates of kinetic theory of gases and deviation from ideal behaviour, Van der Waal's equation of state.

Critical phenomena; PV isotherms of real gases, continuity of states, the isotherms of van der Waal's equation, relationship between critical constants and van der Waal's constants, the law of corresponding states, reduced equation of state.

Molecular Velocities: Root mean square, average and most probable velocities.

Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter, liquifacation of gases (based on Joule – Thomson effect)

III Chemical Kinetics

Rate of reaction, factors influencing the rate of a reaction concentration, temperature, pressure, solvent, light, catalyst Concentration dependence of rates mathematical characteristics of simple chemical reaction. Zero order, first order, second order, pseudo order, half life & mean life. Determination of order of reaction: Differential method Integration method, Method of half life period & Isolation method.

Radioactive decay as a first order phenomenon.

Theories of Chemical Kinetics. Effect of temperature on the rate of reaction, Arrhenius equation and concept of activation energy. Simple collision theory based on hard sphere model. Transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant & thermodynamic aspects.

Section – II (Inorganic Chemistry)

I. Atomic Structure

Evidence for the electrical nature of matter; discharge tube experiments; Thomson's atomic model; Rutherford model; Bohr's model of hydrogen atom; probability picture of electron; quantum numbers; Shapes of s, p, d, orbitals; Aufbau and Pauli exclusion principles, Hund's rule of maximum multiplicity; Electronic configurations of the elements; effective nuclear charge.

II. Chemical Bonding (A)

Covalent bond – Valence Bond Theory (VBT) and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence Shell Electron Pair Repulsion Theory (VSEPR Theory) to NH_3 , H_3O^+ , SF_4 , ClF_3 , ICl_2^- and H_2O . Molecular Orbital Theory, homonuclear and heteronuclear diatomic molecules (CO and NO), multicenter bonding in electron deficient molecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Text Books

1. P.W. Atkins et al., Physical Chemistry, 7th edition
2. J.D. Lee, Concise Inorganic Chemistry, ELBS publications, 4th edition

Reference Books

Physical Chemistry

- 10) Puri, Sharma, Pathania, Principles of Physical Chemistry by Vishal Publishing Company, Oxford University Press
- 11) G. K. Vemulapalli, Physical chemistry, Prentice Hall India, 1993, Donald McQuarrie, Physical Chemistry
G. L. Agarwal, Basic Chemical Kinetics, Tata McGraw-Hill Publication

Inorganic Chemistry

1. B.R. Puri, L.R. Sharma, K.C. Kale, Principles of Inorganic Chemistry Vallabh Publications, First Edition
2. F.A. Cotton and G. Wilkinson Basic Inorganic Chemistry, Wiley Eastern Ltd, 2nd edition, 1993
3. C N R Rao, University General Chemistry, Mc Millan, 1993.
4. Sharpe and Emilus, Inorganic Chemistry, ELBS publications. New edition
5. N.N. Greenwood and Earnshaw, Chemistry of Elements, Pergamon, Oxford, 1984.

BSED CHEM 103 : Organic & Inorganic Chemistry

Section – I (Organic Chemistry)

I. Structure and Bonding:

Hybridization, C-C bond lengths and bond angles, bond energy, localized and delocalized chemical bonds, Definition and examples of Van der Waals interactions, resonance, hyperconjugation, inductive and field effects, intramolecular and intermolecular hydrogen bonding.

II. Fundamentals of Organic Chemistry:

Curved arrow notation, drawing electron movement with arrows, half and double headed arrows, homolytic and heterolytic bond breaking. Types of reagents –

electrophiles and nucleophiles with examples. Types of Organic Reactions: Addition, Elimination, Substitution, Oxidation, Reduction and Rearrangement-one example of each. Energy profile diagrams for exothermic and endothermic reactions, single step and two step reactions. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes; examples, shape and ways of formation. Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanisms (one example each of product analysis, intermediates, isotope effects, kinetic and stereochemical studies). Theory of acids and bases: Lewis concept; Bronsted and Lowry concept

III. Alkanes and cycloalkanes:

IUPAC nomenclature of alkanes. General methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction & decarboxylation of carboxylic acids). Physical properties and chemical reactions of alkanes: halogenation, combustion and pyrolysis. Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity with propane as an example. Cycloalkanes – nomenclature, general methods of formation, Baeyer strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring: banana bonds.

IV. Alkenes, dienes and alkynes:

IUPAC nomenclature of alkenes, general methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hoffmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes – Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO_4 . Mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethene and propene. Nomenclature and classification of dienes, isolated, conjugated and cumulated dienes. Structure and stereochemistry of allenes, methods of formation of butadiene, polymerization. Chemical reactions – 1,2- and 1,4-additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes. General methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, metal-ammonia reduction and polymerization.

Section – II (Inorganic Chemistry)

I. Periodic Properties

Atomic and ionic radii, ionization energy, electron affinity and electronegativity, definition, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behaviour.

II. Acids, Bases and Non Aqueous Solvents

Arrhenius Concept and Bronsted Theory. The Lux – Flood Solvent Systems.

Lewis Concept of Acids and Bases.

Physical Properties of a solvent. Types of Solvents and their general Characteristics.

Reactions in non aqueous solvents with respect to liquid NH_3 and liquid SO_2 .

Text Books

3) Morrison and Boyd, Organic Chemistry;; 6th Edition, Prentice Hall India

4) J.D. Lee, Concise Inorganic Chemistry, ELBS publications, 4th edition

Reference Books

Organic Chemistry

8) Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India

9) Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia

10) Jerry March, Advanced Organic Chemistry; 4rd Edition, John Wiley

Inorganic Chemistry

- B.R. Puri, L.R.Sharma, K.C. Kale, Principles of Inorganic Chemistry Vallabh Publications, First Edition
- F.A. Cotton and G.Wilkinson Basic Inorganic Chemistry, Wiley Eastern Ltd, 2nd edition,1993
- C N R Rao,University General Chemistry , Mc Millan , 1993.
- Sharpe and Emilus, Inorganic Chemistry , , ELBS publications.New edition
- N.N. Greenwood and Earnshaw, Chemistry of Elements, , Pergamon, Oxford,1984.

Laboratory Course for the entire semester i.e. for courses BSEDCEM 101 and BSEDCEM 103:

PHYSICAL CHEMISTRY

Chemical Kinetics :

- 3 Hydrolysis of Methyl Acetate using two different initial concentrations in presence of mineral acid (HCl) as catalyst.
- 3 Relative strength of two acids i.e. HCl & H_2SO_4 .
- 3 Degree of hydrolysis of urea hydrochloride.
- 3 Measurements of viscosity of a given liquid using Ostwald's viscometer (minimum three liquids)

INORGANIC CHEMISTRY

Calibrations and dilutions:

1. Calibration of Burette and Pipettes.
2. To prepare 100 mL of standard 0.1 M $\text{K}_2\text{Cr}_2\text{O}_7$ solution and carry out dilution to 0.05, 0.01, 0.005, and 0.001 M in 100 mL standard flasks.
3. To prepare 100 ppm of Manganese solution using KMnO_4 and carry out dilution

of 5, 10, 15, 20 and 25 mL in 100 mL standard flasks.

4. Semi-micro qualitative analysis:

To analyse 4 - 6 inorganic mixtures containing four ions only. (Two cations and two anions). Mixtures containing the following ions may be prepared

Cations :

Pb^{2+} , Bi^{3+} , Cu^{2+} , Cd^{2+} , Sn^{2+} , Sb^{3+} , Fe^{2+} , Fe^{3+} , Al^{3+} , Cr^{3+} , Zn^{2+} , Mn^{2+} , Ni^{2+} , Co^{2+} , Ba^{2+} , Sr^{2+} , Ca^{2+} , Mg^{2+} , $(\text{NH}_4)^+$, K^+

Anions:

Cl^- , Br^- , I^- , NO_2^- , NO_3^- , SO_3^{2-} , CO_3^{2-} , SO_4^{2-} , CrO_4^{2-} , PO_4^{3-} .

ORGANIC CHEMISTRY

I. **Crystallization:** - a) Benzoic acid from hot water. b) m-dinitrobenzene from ethanol

II. **Sublimations:** - a) *Naphthalene* and b) *Anthracene*

III. Distillation: - a) Separation of acetone and ethyl acetate using water condenser. b) Separation of toluene and nitrobenzene using air condenser.

IV. Qualitative Analysis:

List of compounds

Acids: Benzoic, Acetylsalicylic, Salicylic, Phthalic.

Phenols: Phenol, α -Naphthol, β -Naphthol.

Bases: p-Toluidine, Diphenylamine, o-, m- and p-Nitroanilines,

Aniline. Hydrocarbons: Naphthalene, Anthracene.

Amides: Benzamide, Urea.

Carbonyl compounds: Benzaldehyde, Acetone, Butanone.

Note:

A] 7 compounds of the following types should be analyzed.

Acids – 2; Phenols – 1; Bases – 1; Hydrocarbons – 1; Amide – 1; Carbonyl compds – 1
Tests to be performed are i. Preliminary Tests; ii. Solubility and Chemical type; iii. Elements; iv. Groups and v. Physical Constant.

B] Qualitative analysis is to be performed at a small scale level using preferably not more than 1.0 g. solid and 1.0 ml. liquid.

C] The 7 compounds to be completed in 5 practical, while (I-III) to be completed in two practical.

D] The experiments on distillation/sublimation/crystallization as the case may be are not to be given for examination. However they are not demonstration experiments. Every student is expected to perform these experiments.)

Books suggested for laboratory course

1. Vogel's Qualitative Inorganic Analysis, (revised) Svehla, Orient Longman.
- Vogel's textbook of Quantitative Inorganic analysis (revised) J. Basset, R.C.
- Mann and Saunders, Practical Organic Chemistry
- N.K. Vishnoi, Practical Organic Chemistry
- P. S. Sindhu, Practicals in Physical Chemistry, Macmillan India Ltd., First Edition, 2006.

SEMESTER – II

BSEDCHEM 102: Physical & Inorganic Chemistry

Section - I (Physical Chemistry)

I Thermodynamics

Thermodynamic terms: System, surrounding, types of systems, intensive & extensive properties. State & path functions & their differentials. Thermodynamic process.

Concept of work & heat

First law of thermodynamics : statements and definitions of internal energy & enthalpy.

Heat capacities at constant volume & pressure & their relationship. Joule's law, Joule-

Thomson coefficient & inversion temperature . Calculation of w , q , dU , dH , for the expansion of ideal gases under isothermal & adiabatic conditions for reversible processes. Thermochemistry : standard state, standard enthalpy of formation . Hess's law of heat summation & its applications. Heat of reaction at constant pressure & at constant volume . Enthalpy of neutralization, bond dissociation energy & its calculation from thermochemical data. Temperature dependence of enthalpy. Kirchoff's equation.

II Solutions, Dilute Solutions and Colligative Properties

Ideal & non ideal solutions, methods of expressing concentrations of solutions, activity & activity coefficients.

Dilute solutions, colligative properties, Rault's law , relative lowering of vapour pressure molecular weight determination. Osmosis: osmotic pressure & its measurement, depression of freezing point, thermodynamic derivation of relation between molecular weight and depression of freezing point. Elevation in boiling point thermodynamic derivation of relation between molecular weight and elevation in boiling point. Experimental methods for determining various colligative properties.

III Liquid State and Applications

Intermolecular forces, structure of liquids (Qualitative description) Structural differences between solids, liquids and gases.

Liquid crystal : Difference between liquid crystals ,solid and liquid. Classification, structure of nematic and cholestric phases. Thermography and seven segment cell. Surface between a liquid and vapour .Surface tension by capillary rise method, stalagmometer method .Viscosity of liquids, Poiseuille equation, use of Ostwald's Viscometer.

Section – II (Inorganic Chemistry)

I. s – block elements

Comparative study including diagonal relationship of groups, salient features of

Hydrides, solvation and complexation tendencies including their function in biosystems. An introduction to alkyls and aryls.

II. p - block elements (A)

Comparative study including diagonal relationship of groups 13 and 14.

Group 13--- Hydrides of Boron, diborane, and higher boranes, borazine, borohydrides.

Group 14 ---Fullerenes, carbides, fluorocarbons, silicates (structural principle)

Text Books :

1. P.W. Atkins et al., Physical Chemistry, 7th edition
2. J.D. Lee, Concise Inorganic Chemistry, ELBS publications, 4th edition

Reference Books

Physical Chemistry

1. Puri, Sharma, Pathania, Principles of Physical Chemistry by Vishal Publishing Company, Oxford University Press
2. G. K. Vemulapalli, Physical chemistry, Prentice Hall India, 1993, Donald McQuarrie, Physical Chemistry
G. L. Agarwal, Basic Chemical Kinetics, Tata McGraw-Hill Publication

Inorganic Chemistry

8. B.R. Puri, L.R.Sharma, K.C. Kale, Principles of Inorganic Chemistry Vallabh Publications, First Edition
9. F.A. Cotton and G.Wilkinson Basic Inorganic Chemistry, Wiley Eastern Ltd, 2nd edition, 1993
10. C N R Rao, University General Chemistry, Mc Millan, 1993.
11. Sharpe and Emilus, Inorganic Chemistry, ELBS publications. New edition
12. N.N. Greenwood and Earnshaw, Chemistry of Elements, Pergamon, Oxford, 1984

BSED CHEM 104 : Organic & Inorganic Chemistry

Section – I (Organic Chemistry)

I. Stereochemistry of organic compounds:

Newman and saw horse formulae, Fischer and flying wedge formulae.

Concept of isomerism. Types of isomerism. Conformational isomerism –

Conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono-substituted cyclohexane derivatives.

Optical isomerism – elements of symmetry, molecular chirality, definition and examples of enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Specification of configuration at chiral centers: Sequence rules and R:S system of nomenclature.

Geometric Isomerism - Determination of configuration of geometric isomers.

E and Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

Difference between configuration and conformation.

II. Arenes and Aromaticity

Nomenclature of benzene derivatives. Structure of benzene: molecular formula and Kekule structure. Stability and C–C bond lengths of benzene, resonance structure, MO picture. Aromaticity: The Huckel's rule, aromatic ions, anti-aromaticity. Aromatic electrophilic substitution – general pattern of the mechanism role of σ - and π - complexes. Mechanism of nitration, halogenation, sulphonation and Friedel-Crafts reaction. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction. General methods of formation and chemical reactions of alkyl benzenes – reduction, oxidation, ring and side chain substitution.

III. Alkyl and aryl halides:

Nomenclature and classes of alkyl halides, general methods of formation, chemical reactions. Mechanism and stereochemistry of nucleophilic substitution reactions of alkyl halides, SN_2 and SN_1 reactions with energy profile diagrams, solvent effect.

The addition – elimination (bimolecular displacement) and the elimination – addition (benzyne) mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs. allyl, vinyl and aryl halides.

Section – II(Inorganic Chemistry)

I. p - block elements (B)

Comparative study including diagonal relationship of groups 15, 16 and 17. group 15- phosphazenes, group 16—tetra sulfur tetranitride, group 17—basic properties of halogens, interhalogens and polyhalides.

II. Chemistry of Noble Gases

Chemical properties of Noble Gases, Chemistry of Xenon, structure and bonding in Xenon compounds,

Text Books

2. Morrison and Boyd, Organic Chemistry;; 6th Edition, Prentice Hall India
3. J.D. Lee, Concise Inorganic Chemistry, ELBS publications, 4th edition

Reference Books

Organic Chemistry

- 1 Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India
- 2 Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia
- 3 Jerry March, Advanced Organic Chemistry; 3rd Edition, John Wiley

Inorganic Chemistry

1. B.R. Puri, L.R.Sharma, K.C. Kale, Principles of Inorganic Chemistry Vallabh Publications, First Edition

2. F.A. Cotton and G.Wilkinson Basic Inorganic Chemistry,
Wiley Eastern Ltd, 2nd edition,1993
3. C N R Rao,University General Chemistry , Mc Millan , 1993.
4. Sharpe and Emilus, Inorganic Chemistry , , ELBS publications.New edition

Laboratory Course for the entire semester i.e for courses 102 and 104:

PHYSICAL CHEMISTRY

- V) Measurements of surface tension of a given liquid using stalagmometer (minimum three liquids)*
- W)Preparation of standard solutions based on normality, molarity, molality. Also further dilutions from a standard solution are expected (e.g. KMnO_4 , NaOH etc.)*
- X) Preparation of standard solutions based on ppm and mole fraction. Also further dilutions from a standard ppm solution are expected(e.g. Oxalic acid, CuSO_4)*
- Y) To investigate the order of the reaction between $\text{K}_2\text{S}_2\text{O}_8 + \text{KI}$ ($a = b$)*

INORGANIC CHEMISTRY

Volumetry: (Double Burette*)

1. To prepare 0.1 N Na_2CO_3 / Borax solution and standardize the given ≈ 0.1 N HCl solution.
2. To prepare 0.1 N Succinic acid/KHP solution and standardize the given ≈ 0.1 N NaOH solution.

Volumetry: (Single Burette)

1. To prepare 0.05 N $\text{Na}_2\text{C}_2\text{O}_4$ solution and standardize the given KMnO_4 solution.
2. To prepare 0.005 M EDTA solution and estimate the amount of Zn^{2+} and Mg^{2+} from $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ and $\text{MgSO}_4 \cdot 6\text{H}_2\text{O}$ solutions respectively.

Gravimetric analysis:

6. $\text{NH}_4\text{Cl} + \text{BaSO}_4$
7. $\text{ZnO} + \text{ZnCO}_3$

5.Note: The prepared solution in burette no. 1to be titrated with given solution in burette no. 2 with indicator added once for the first titration, without throwing out the conical flask content. Plot the readings from burette no. 1 v/s readings from burette no. 2 and from the graph, calculate the normality of solution in burette no. 2.

ORGANIC CHEMISTRY

1. Qualitative Analysis

List of compounds

Alkyl and aryl halides: Chloroform, Carbon tetrachloride, Chlorobenzene, Bromobenzene, p-dichlorobenzene.

Nitrohydrocarbons: Nitrobenzene, m-dinitrobenzene, p-nitrotoluene.

Bases: α -Naphthylamine, Diphenylamine, o-, m- and p-Nitroanilines,

N-methylaniline, N,N-dimethylaniline. Alcohols:

Methanol, Ethanol, 2-propanol, Cyclohexanol.

Esters: Methyl acetate, Ethyl acetate, Ethyl benzoate, Methyl salicylate.

Anilides: Acetanilide, Benzanilide

Carbohydrates: Glucose, Fructose, Mannose

Note: 7 compounds of the following type to be analyzed in 5 practicals: Carbohydrate – 1; Anilide – 1; Ester – 1; Alcohol – 1; Nitrohydrocarbon -1; Alkyl or aryl halide – 1; Base – 1.

Books suggested for laboratory course

- 2) Vogel's Qualitative Inorganic Analysis, (revised) Svehla, Orient Longman.
 - 3) Mann and Saunders, Practical Organic Chemistry
 - 4) N.K. Vishnoi, Practical Organic Chemistry
 - 5) Vogel's textbook of Quantitative Inorganic analysis (revised) J. Basset, R.C.
 - 6) P. S. Sindhu, Practicals in Physical Chemistry, Macmillan India Ltd., First Edition, 2006.
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S. Y. B. Sc CHEMISTRY SYLLABUS

SEMESTER – III: COURSES BSEDChem 201 AND BSEDChem 203

SEMESTER – IV: COURSES BSEDChem 202 AND BSEDChem 204

SEMESTER – III

BSEDChem 201: Physical & Inorganic Chemistry

Section - I (Physical Chemistry)

I. Thermodynamics

Second law of thermodynamics: need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature.

Concept of entropy :entropy as a state function ,entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality ,entropy as a criteria of spontaneity and equilibrium .Entropy change in ideal gases and mixing of gases.

Third law of thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions; Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as criteria for thermodynamic equilibrium and spontaneity, their advantages over entropy change. Variation of G and A with P, V & T.

II. Chemical Equilibrium

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle.

Reaction isotherm and reaction isochore – Clapeyron equation and Clausius – Clapeyron equation, applications

III. Phase Equilibrium

Statement and meaning of the terms –phase , component and degree of freedom

,derivation of Gibbs phase rule, phase equilibria of one component system –water,CO₂

and S systems.

Phase equilibria of two component system – solid –liquid equilibria, simple eutectic –Bi-Cd, Pb-Ag systems, desilverisation of lead.

Solid solutions –compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H₂O), (FeCl₃-H₂O) and (CuSO₄-H₂O) system. Freezing mixtures, acetone –dry ice.

Liquids –liquid mixtures – ideal liquid mixtures, Raoult's and Henry's law. Non –ideal system –azeotropes- HCl-H₂O and ethanol – water systems

Partially miscible liquids –phenol –water, trimethylamine –water, nicotine –water systems.

Lower and upper consolute temperature. Effect of impurity on consolute temperature.

Immiscible liquids, steam distillation.

Nernst distribution law – thermodynamic derivation, applications.

Section – II (Inorganic Chemistry)

I. Chemistry of the Elements of the First Transition Series.

. Characteristic properties of the d-Block elements. Properties of the elements of the first transition series, their binary compounds, and complexes illustrating relative stability of their oxidation states, co-ordination number and geometry.

II. Co-ordination compounds

Werner's co-ordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of co-ordination compounds

Text Books

1. P.W. Atkins et al., Physical Chemistry, 7th edition
1. J.D. Lee, Concise Inorganic Chemistry, ELBS Publications, 4th edition

Reference Books

Physical Chemistry

- 12) Puri, Sharma, Pathania, Principles of Physical Chemistry, Vishal Publishing Company, Oxford University Press
- 13) G. K. Vemulapalli, Physical Chemistry, Prentice Hall India, 1993,
- 14) Donald McQuarrie, Physical Chemistry

Inorganic Chemistry

11. B.R. Puri, L.R.Sharma, K.C. Kale, Principles of Inorganic Chemistry Vallabh Publications, First Edition
12. F.A. Cotton and G.Wilkinson Basic Inorganic Chemistry, Wiley Eastern Ltd, 2nd edition, 1993
8. C N R Rao, University General Chemistry, Mc Millan, 1993.
9. Sharpe and Emilus, Inorganic Chemistry, ELBS Publications. New edition
10. N.N. Greenwood and Earnshaw, Chemistry of Elements, Pergamon, Oxford, 1984

Laboratory Course

Physical Chemistry

- 8) To determine the partition coefficient of I₂ between C₂H₄Cl₂ and H₂O.

- 9) To determine molecular condition of the given acid in benzene/toluene by the partition coefficient method.
- 10) To determine the amount of strong acid (HCl) present in the given solution by conductometric titration using standard NaOH solution.
- 11) To determine the amount of weak acid (CH_3COOH) present in the given solution by conductometric titration using standard NaOH solution.
- 12) To study the solubility of benzoic acid at room temperature and below room temperature by volumetric method.

Inorganic Chemistry:

Gravimetric estimations:

- 14) Ba as BaSO_4
- 15) Fe as Fe_2O_3

BSEDCHEM 203:Organic & Inorganic Chemistry

Section - I (Organic Chemistry)

I. Electromagnetic Spectrum: Absorption Spectra

Ultraviolet (UV) absorption spectroscopy – Absorption laws (Beer-Lambert law), Molar absorptivity, presentation and analysis of UV spectra, Types of electronic transitions, effect of conjugation. Concept of chromophore and auxochromes, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. UV spectra of conjugated dienes and enones, Woodward-Fieser rules for calculation of UV maxima of the above two systems. Numerical problems on above.

Infra Red (IR) absorption spectroscopy – Molecular vibrations, Hooke's law, selection rules, Intensity and position of IR bands, measurement of IR spectrum, Finger print region and its use to establish identity, Applications to determine purity, to study progress of chemical reactions and hydrogen bonding. Characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds. Simple problems in structure elucidation using UV and IR spectroscopy.

II. Alcohols

Classification and nomenclature. Monohydric alcohols – Methods of preparations by reduction of carbonyl compounds, carboxylic acids, and esters, using Grignard reaction. Hydrogen bonding, acidic nature. Reactions of alcohols – esterification, oxidation and dehydration.

Dihydric alcohols – Nomenclature, methods of preparation by hydroxylation of alkenes and acid catalyzed opening of epoxides. Reactions of vicinal glycols – pinacol-pinacolone rearrangement with mechanism

III. Ethers and Epoxides

Nomenclature of ethers and methods of preparation by Williamson synthesis, from alcohols by use of diazomethane and by use of H_2SO_4 . Physical properties. Chemical reactions: cleavage with HI.

Synthesis of epoxides by reaction of alkenes with peracids and by elimination from vicinal halohydrins. Acid and base catalyzed ring opening of epoxides, orientation of ring opening, reactions of Grignard and organolithium reagents with epoxides.

IV. Aldehydes and Ketones:

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes by oxidation of alcohols and reduction of acid chlorides, synthesis of ketones by oxidation of alcohols, from nitriles by Grignard reaction and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, reaction with ammonia and its derivatives, Wittig reaction and Mannich reaction. Halogenation of enolizable ketones. Mechanisms and one application each of the above reactions.

Section – II (Inorganic Chemistry)

I. Oxidation and Reduction

Use of redox potential data-analysis of redox cycle, redox stability in water –frost, Latimer and pourbaix diagrams. Principles involved in the extraction of the elements.

II. Chemistry of the Lanthanide Elements

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

Text Books

13) Morrison and Boyd, Organic Chemistry;; 6th Edition, Prentice Hall India

14) J.D. Lee, Concise Inorganic Chemistry, ELBS Publications, 4th Edition

Reference Books

Organic Chemistry

5. Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India

6. Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia

7. Jerry March, Advanced Organic Chemistry; 3rd Edition, John Wiley

8. Silverstein, Bassler and Morill, Spectrometric Identification of Organic Compounds

Inorganic Chemistry

20. B.R. Puri, L.R.Sharma, K.C. Kale, Principles of Inorganic Chemistry Vallabh Publications, First Edition

21. F.A. Cotton and G.Wilkinson Basic Inorganic Chemistry, Wiley Eastern Ltd, 2nd Edition, 1993

21. C N R Rao, University General Chemistry , Mc Millan , 1993.

22. Sharpe and Emilus, Inorganic Chemistry , , ELBS Publications.New Edition

23. N.N. Greenwood and Earnshaw, Chemistry of Elements, , Pergamon, Oxford, 1984.

Laboratory Course

Organic Chemistry:

Organic Estimations:

Estimations of Acetamide, Aniline and Glucose.

Organic Derivatives: Benzoyl Derivative of β -naphthol and aniline.

Bromo Derivative of phenol and aniline.

Note: 1] The Organic Derivatives to be completed in 2 practicals.

2] Organic Estimations / Organic Derivatives to be given for examination.

Inorganic Chemistry:

Gravimetric Estimations

- 4) Mn as Mn-pyrophosphate
- 5) Ni as Ni-DMG
- 6) Al as Al_2O_3 from aluminium sulphate

Books suggested for laboratory course

- 10. Vogel's Qualitative Inorganic Analysis, (revised) Svehla, Orient Longman.
- 11. Vogel's textbook of Quantitative Inorganic Analysis (revised) J. Basset, R.C.
- 12. P. S. Sindhu, Practicals in Physical Chemistry, Macmillan India Ltd., First Edition, 2006.

SEMESTER – IV

BSEDCEM 202:Physical and Inorganic Chemistry

Section - I (Physical Chemistry)

I. Electrochemistry

Electrical transport –conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law its uses and limitations. Debye –Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method.

Applications of conductivity measurements :determination of degree of dissociation, determination of K_a of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

II. Solid State

Definition of space lattice, unit cell.

Laws of crystallography –(i) law of constancy of interfacial angles

(ii) law of rationality of indices (iii) law of symmetry elements in crystals.

X-ray diffraction by crystals. derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).

III. Colloidal State

Definition of colloids, classification of colloids.

Solids in liquids (sols): properties –kinetic, optical and electrical; stability of colloids, protective action, Hardy- Schulze law gold number.

Liquids in liquids (emulsions): types of emulsions, preparation .Emulsifier
Liquids in solids (gels): classification, preparation and properties, inhibition, general applications of colloids

Section - II (Inorganic Chemistry)

I. Chemistry of the elements of the second and third transition series

General characteristics, comparative treatment with their 3d analogues in respect of Ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.

II. Co-ordination Compounds

Isomerism in co-ordination compounds, valence bond theory of transition metal complexes

Text Books

- 2 P.W. Atkins et al., Physical Chemistry, 7th edition
6. J.D. Lee, Concise Inorganic Chemistry, ELBS Publications, 4th Edition

Reference Books

Physical Chemistry

- * Puri, Sharma, Pathania, Principles of Physical Chemistry by Vishal Publishing Company, Oxford University Press
- * G. K. Vemulapalli, Physical Chemistry, Prentice Hall India, 1993,
- * Donald McQuarrie, Physical Chemistry

Inorganic Chemistry

- 10) B.R. Puri, L.R.Sharma, K.C. Kale, Principles of Inorganic Chemistry Vallabh Publications, First Edition
- 11) F.A. Cotton and G.Wilkinson Basic Inorganic Chemistry, Wiley Eastern Ltd, 2nd Edition, 1993
9. C N R Rao, University General Chemistry, Mc Millan, 1993.
10. Sharpe and Emilus, Inorganic Chemistry, ELBS Publications. New Edition
11. N.N. Greenwood and Earnshaw, Chemistry of Elements, Pergamon, Oxford, 1984

Laboratory Course

Physical Chemistry

13. To determine the amount of chloride ion present in given solution by conductometric method.
14. To determine the solubility and solubility product of sparingly soluble salts (BaSO_4 , PbSO_4 , CaSO_4 , SrSO_4) by conductometric method.
15. To study the kinetics of inversion of cane sugar in the presence of HCl solution
16. To investigate reaction between H_2O_2 and HI.
17. To investigate reaction between HBrO_3 and HI.

Note: Polarimeter experiment is to be performed by each student and is not a

demonstration experiment.

Inorganic Chemistry:

Volumetric analysis

7. Estimation of Cu by EDTA method.
8. Estimation of Fe^{2+} using internal indicator by potassium dichromate method.
9. Determination of alkali content in antacid tablet using Standard HCl solution.

BSED/CHEM 204: Organic and Inorganic Chemistry

Section - I (Organic Chemistry)

I. Phenols

Nomenclature, structure and bonding. Preparation of phenols by alkali fusion of aromatic sulphonic acids, Dow's process from chlorobenzene and from Cumene through hydroperoxide rearrangement with mechanism. Physical properties and acidic character. Comparative acid strengths of alcohols and phenols, resonance stabilization of the phenoxide ion. Reaction of phenols – Electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gattermann synthesis and Reimer-Tiemann reaction.

II. Oxidation and Reduction reactions of carbonyl compounds

Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, Meerwein-Ponndorf-Verley, Clemmensen, Wolff-Kishner, LiAlH_4 and NaBH_4 reduction. Mechanisms and one application each of the above reactions

III. Carboxylic Acids

Nomenclature, structure and bonding. Physical properties, acidity and effects of substituents on acid strength. Preparation of carboxylic acids by oxidation of carbonyl compounds, carbonation of Grignard reagent, hydrolysis of cyanides, preparation of aromatic acids by oxidation of alkyl benzenes. Reactions of carboxylic acids. Hell-Volhard-Zelinsky reaction, synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids. Mechanism of decarboxylation.

Dicarboxylic acids: Methods of preparation and effect of heat and dehydrating agents with reference to malonic acid only.

IV. Carboxylic Acids Derivatives

Structure and nomenclature of acid chlorides, esters, amides and acid anhydrides. Physical properties. Methods of preparation from carboxylic acids and interconversion of acid derivatives by nucleophilic acyl substitution. Mechanisms of esterification and acidic and basic hydrolysis of esters with evidences.

V. Organic Compounds of Nitrogen

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid – preparation and properties.

Structure and nomenclature of amines, physical properties. Stereochemistry of amines.

Separation of a mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amine. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines by reduction of nitro compounds and nitriles, reductive amination of carbonyl compounds, Gabriel phthalimide reaction and Hofmann bromamide reaction.

Section - II (Inorganic Chemistry)

I. Chemistry of Actinides

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between later actinides and later lanthanides.

II. Ionic Solids

Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, salvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule, metallic bond - free electron, valence bond and band theories.

Text Books

16. Morrison and Boyd, Organic Chemistry;; 6th Edition, Prentice Hall India

17. J.D. Lee, Concise Inorganic Chemistry, ELBS Publications, 4th Edition

Reference Books

Organic Chemistry

14. Francis Carey, Organic Chemistry; 3rd Edition, Tata McGraw Hill India

15. Paula Yurkanis Bruice, Organic Chemistry; 3rd Edition, Pearson Education Asia

16. Jerry March, Advanced Organic Chemistry; 3rd Edition, John Wiley

17. Silverstein, Bassler and Morill, Spectrometric Identification of Organic Compounds

Inorganic Chemistry

6) B.R. Puri, L.R.Sharma, K.C. Kale, Principles of Inorganic Chemistry
Vallabh Publications, First Edition

7) F.A. Cotton and G.Wilkinson Basic Inorganic Chemistry,
Wiley Eastern Ltd, 2nd Edition, 1993

k) C N R Rao, University General Chemistry , Mc Millan , 1993.

l) Sharpe and Emilus, Inorganic Chemistry , , ELBS Publications.New Edition

m) N.N. Greenwood and Earnshaw, Chemistry of Elements, , Pergamon, Oxford, 1984.

Laboratory Course

Organic Chemistry Qualitative Analysis: - At least 5 compounds to be analyzed from the following compounds.

List of compounds

Acids: Cinnamic, o-Chlorobenzoic, Salicylic, Succinic, Oxalic, p-nitrobenzoic, p-hydroxybenzoic, Sulphanic acid.

Phenols: o- and m- Nitrophenols, Resorcinol.

Bases: p-Toluidine, Diphenylamine, o-, m- and p-nitroanilines, N-methylaniline, N,N-dimethylaniline

Hydrocarbons: Naphthalene, Anthracene, Toluene.

Amides: Benzamide, Urea, Thiourea

Carbonyl compounds: Salicylaldehyde, Furfural, Butanone, Acetophenone, Benzophenone, Camphor.

Alkyl and aryl halides: Chloroform, Chlorobenzene, Bromobenzene, p-Dichlorobenzene

Nitrohydrocarbons: m-Dinitrobenzene, p-Nitrotoluene,

Alcohols: 2-Propanol, Cyclohexanol

Esters: Ethyl benzoate, Methyl salicylate

Anilides: Acetanilide, Benzanilide

Note: 5 compounds of the following type to be analyzed in **3 Practical** : Acid – 1 , Phenol – 1, Amides – 1 , Hydro carbon – 1 , Anilide – 1; Ester – 1; Alcohol – 1; Nitrohydrocarbons -1; Alkyl or aryl halides – 1; Bases – 1.

Tests to be performed are i. Preliminary tests; ii. Solubility and Chemical type; iii. Elements; iv. Groups and v. Physical constants.

Qualitative analysis is to be performed at a micro scale level using not more than 1g. solid and 1 ml. liquid.

Finding the organic mixture type: Solid-solid-Water Insoluble type. Acid-Base 2) Acid-Neutral 3) Acid-Phenol 4) Phenol-Base 5) Phenol-Neutral 6) Base-Neutral

Note: 5 mixtures to given for chemical type determination in 2 practicals (not to be given for examination)

Inorganic Chemistry

Volumetric analysis:

- iii) Estimation of Ca by EDTA (3 solutions of different salts of Ca).
- iv) Estimation of Ni by EDTA (3 solutions of different salts of Ni).

Books suggested for laboratory course

- 2. Vogel's Qualitative Inorganic Analysis, (revised) Svehla, Orient Longman.
- viii) Vogel's textbook of Quantitative Inorganic Analysis (revised) J. Basset, R.C.
- ix) P. S. Sindhu, Practicals in Physical Chemistry, Macmillan India Ltd., First Edition, 2006.

SEMESTER V

Theory Courses

BSEDCEM 311: Physical Chemistry

BSEDCEM 321: Inorganic Chemistry

BSEDCEM 331: Organic Chemistry

Laboratory Courses

BSEDCEM 301: Experiments in Physical and Analytical Chemistry

:Project

SEMESTER VI

BSEDCEM 341: Analytical Chemistry

BSEDCEM 351: Environmental Chemistry

BSEDCEM 361: Pharmaceutical Chemistry

BSED CHEM 311: Physical Chemistry

Section I

1. Quantum Chemistry:

De Broglie hypothesis, the Heisenberg's uncertainty principle, sinusoidal wave equation, Hamiltonian operator, Schrödinger wave equation and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in one dimensional box.

Schrödinger wave equation for H-atom, separation into three equations (without derivation), quantum numbers and their importance, hydrogen like wave function, radial wave functions, angular wave functions.

2. Electrochemistry:- I

Electrolytic and galvanic cells; reversible and irreversible cells, conventional representation of electrochemical cells; types of reversible electrodes; gas –metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, electrode reaction; Nernst equation; derivation of cell E.M.F. and single electrode potential, reference electrodes, standard hydrogen electrode; calomel electrodes ;standard electrodes potential, sign convention, electrochemical series and its applications.

3. Molecular Structure:

Optical activity and molecular structure; polarization (Mosotti-Clausius equation), orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment; temperature method and refractivity method, dipole moment and structure of molecules.

4. Nuclear Chemistry: - I

Composition of the nucleus. Nuclear binding forces, binding energy, stability, nucleon-nucleon forces and their equality, characteristics and theory of nuclear forces. Nuclear models, the shell model, liquid drop model and its merits. Theory of radioactive disintegration, rate of disintegration half, average life of radio element, units of radioactivity, definition and characteristics of artificial radioactivity.

Section II

5. Electrochemistry :-II

EMF of a cell and its measurements; Concentration cells (both electrodes and electrolytes) with and without transport; liquid junction potential and its measurement; Application of concentration cell; determination of ionic product of water; transport number of ions; solubility and solubility product. Polarization; elimination of polarization; decomposition potential, measurement of decomposition potential ; factor affecting decomposition potential over voltage and types of over voltage; measurement of over voltage ; factor affecting over voltage

6. Molecular structure and molecular spectra:

Introduction to electromagnetic radiation; regions of the spectrum; statement of the Born-Oppenheimer approximation; degrees of freedom.

Rotational Spectrum: Diatomic molecules, energy level of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution); determination of bond length, qualitative description of non-rigid rotor, isotope effect.

7. Nuclear Chemistry:-II

Determination and measurements of radioactivity: Ionisation current measurements; saturation collection; multiplicative ion collection; the Geiger-Muller Counter, characteristics of an ideal Geiger-Muller Counter, proportional counter. methods based on photon collection, Scintillation counter, characteristics of a suitable Scintillator.

(For the list of references see after Semester VI syllabus)

BSEDCHEM 321: Inorganic Chemistry

Section – I

1. Metal-Ligand Bonding in Transition Metal Complexes:

Limitations of Valence bond theory, Crystal field theory (CFT) splitting of d- orbitals in octahedral, tetrahedral and square planar complexes. Crystal Field Stabilization Energy (CFSE), Measurement of 10 Dq for $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex, Factors affecting 10 Dq, Spectrochemical series, Effect of crystal field splitting on properties of Octahedral complexes: Magnetic, Spectral.

Ref: 2, 3

2. Bio-inorganic Chemistry (I)

Overview, essential and trace elements in biological processes, Metalloporphyrins with special reference to haemoglobin and myoglobin. .

Ref: 2, 6

3. Inorganic solid state chemistry (I)

Introduction, Preparation of Nonmolecular solids, Band gaps, Metals, Insulators and Semi-conductors.

Ref: 2

SECTION – II

4. Organometallic chemistry

(A) Definition, nomenclature and classification of organometallic compounds, EAN rule, 18 electron rule. General methods of preparations and properties. Structure and bonding in mononuclear metal carbonyls: $\text{Ni}(\text{CO})_4$, $\text{Fe}(\text{CO})_5$ and $\text{Cr}(\text{CO})_6$ (Orbital diagram not expected)

(B) Polynuclear metal carbonyl: preparation and structures of $\text{Mn}_2(\text{CO})_{10}$, $\text{Fe}_2(\text{CO})_9$ and $\text{Fe}_3(\text{CO})_{12}$ (Orbital diagram not expected)

(C) Sandwich compounds like Ferrocene: preparation, properties, reactions, structure and bonding.

(D) Preparation and properties of alkyl and aryls of Li, Al, Hg and Ti.

Ref: 2, 3, 4, 5, 6

5. Bio-inorganic Chemistry (II)

The role of Model systems, The alkali and alkaline earth metals, Metalloenzymes, Nitrogen fixation cycle.

Ref: 2

6. Inorganic solid state chemistry (II)

Defects in Solids, Point defects: Schottky and Frenkel, Color center, extended defects. Non-stoichiometry.

Ref: 6

Text- Books:

- 15) Concise Inorganic Chemistry. 5th edition, J. D. Lee

16) Basic Inorganic Chemistry, 5th edition, F.A. Cotton, G. Wilkinson.

Reference books

17) College Inorganic Chemistry for T.Y. B. Sc. Laxmi Devi, Patel, Dhume, Turakia, Dixit 18th revised edition, Himalaya Publishing House.

18) Principles of Inorganic Chemistry, B.R Puri, L. R. Sharma, Milestone Publishers.

19) Inorganic Chemistry, (Principles of Structure and Reactivity). James E. Huheey, Ellen A. Keiter, Richard L. Keiter

20) Inorganic Chemistry D. E. Shriver, P.W. Atkins and C.H. Langford, Oxford.

21) Advance Inorganic Chemistry, 6th edition, F.A. Cotton and G. Wilkinson

22) Comprehensive Inorganic Chemistry, B.S. Bahl and Sharma

23) Group theory and its Chemical applications, P. K. Bhattacharya, Himalaya Publication.

24) Environmental Chemistry, A. K. De.

BSEDCHEM 331: Organic Chemistry

Section - I

1. Spectroscopy:

Proton Magnetic Resonance (¹H NMR) spectroscopy, theory, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, intensity of peaks, interpretation of PMR spectra of simple organic molecules. ¹³C Magnetic Resonance: Number of signals, splitting of signals – proton coupled and decoupled spectra, off resonance decoupled spectra. ¹³CMR chemical shifts – identification of hybridization of carbons and nature of functionalization. Mass Spectrometry: Simple idea of instrumentation, Definitions of parent or molecular ion peak and base peak. Isotope effect with respect to alkyl halides, Fragmentation of ketones – α cleavage and Mc Lafferty rearrangement.

Problems pertaining to the structure elucidation of simple organic molecules using spectroscopic techniques (UV, IR, PMR, CMR and MS). Types of problems to be specified. UV and IR to be used as supporting data. Types of CMR and Mass spectroscopy problems to be specified.

2. Alkaloids:

Structure elucidation and synthesis of Nicotine, Atropine and Papaverine

3. Stereochemistry of Reactions:

Mechanism and stereochemistry of (i) Addition of halogens and halogen acids to open chain alkenes. Markownikoff's and anti- Markownikoff's addition. (ii) SN₁, SN₂, SN_i, substitutions and (iii) E₁, E₂ and E_{1cb} elimination reactions.

SECTION- II

4. Heterocyclic Compounds:

Introduction, Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed 5 and 6 membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and

Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

5. Vitamins and Hormones:

Vitamins: Importance and classification. Structure elucidation and synthesis of Vitamins A and C.

Hormones: Important hormones and their uses. Structure elucidation and synthesis of Thyroxine and Adrenaline.

6. Amino acids, Peptides, Proteins and Nucleic Acids:

Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α -amino acids.

Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical methods of peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins. Levels of protein structures. Protein denaturation/renaturation.

Nucleic acids: Introduction. Hydrolysis of nucleic acids. Ribonucleosides and ribonucleotides. General idea of the double helical structure of DNA

LABORATORY COURSES

Semester V

BSEDCHEM 301: Experiments in Physical and Analytical / Pharmaceutical Chemistry

PHYSICAL CHEMISTRY

(Note 3 unit students will perform only experiments No. 1, 3, 6 and 8 as given below and No. 1,4,7 and 8 given on page 16 of Sem. VI physical chemistry)

Conductometry

1. To determine the percent composition of acid mixture (strong and weak acid) by titrating against standard 0.1 N NaOH solution.
3. To verify Ostwald's dilution law using CH_3COOH

Potentiometry

4. To determine the formal redox potential of $\text{Fe}^{2+}/\text{Fe}^{3+}$ system using standard 0.1N $\text{K}_2\text{Cr}_2\text{O}_7$ solution.
4. To determine the solubility product of AgCl/AgBr .

pH metry

6. To determine the dissociation constant of weak monobasic acid (CH_3COOH) by titrating against standard 0.1N NaOH solution.

General

- 6 Partition Coefficient: To determine the equilibrium constant for the reaction $\text{KI} + \text{I}_2 \rightleftharpoons \text{KI}_3$
- 5) Adsorption: To study the adsorption of acetic acid from aqueous solution by activated charcoal and verify Freundlich adsorption isotherm.
- 6) Chemical Kinetics: To study the acid hydrolysis of methyl acetate at two different temperature and determine the energy of activation.

ANALYTICAL CHEMISTRY

(3 unit students will not perform any practical in Analytical Chemistry in sem. V)

A] Spectrophotometry.

- 11) Determination of Mn^{2+} in steel or Mn^{2+} ion concentration periodate method.
- 12) Determination of iron by salicylic acid method.

B] Chromatography

- Separation of metal ions by paper chromatography.(demonstration)
- Separation of organic compounds by TLC.(demonstration)
- $\text{Zn}^{2+}/\text{Mg}^{2+}$ separation by an anion exchanger & their volumetric estimation of with standard EDTA.

C] Conductometry

- Estimate the amount of Pb present in a solution of $\text{Pb}(\text{NO}_3)_2$ by conductometric titration with Na_2SO_4

D] Other Experiments

- 3 Determination of ascorbic acid in Vitamin C tablets by iodometry
- 3 Estimation of Ca in milk powder using EDTA method (volumetry) and also by precipitation as oxalate followed by titration with KMnO_4 (not for examination)

PHARMACEUTICAL CHEMISTRY**A] Volumetric Exercises**

4. Estimation of acetyl salicylic acid in the given aspirin tablet by titrating against 0.1N alcoholic KOH potentiometrically.
5. Estimation of Ascorbic acid in tablets by iodometry.

Preparations**A Preparation of Aspirin from salicylic acid**

-- Preparation of Hippuric acid from glycine.

B] Chromatography

- 12) Separation of $\text{Zn}^{2+}/\text{Mg}^{2+}$ by anion exchange and volumetric estimation of Mg^{2+} .
- 13) Separation of $\text{Zn}^{2+}/\text{Mg}^{2+}$ by anion exchange and volumetric estimation of Zn^{2+} .
- 14) Estimation of Na^+ from NaCl using cation exchanger.

C] Spectrophotometry

12. Determination of iron with 1,10-phenanthroline or salicylic acid.
13. Determination of nitrite in water.
18. Determination of purity of paracetamol spectrophotometrically.

Calibration of uv-visible spectrophotometer (Not to be evaluated for examination)

SEMESTER VI**BSED/CHEM 341: Analytical Chemistry****Section I****1. Introduction**

Scope and importance of analytical chemistry

Chemical analysis and analytical chemistry

Analytical process (steps involved in chemical analysis): defining the problem, sampling, separation of desired components, actual analysis, presentation and interpretation of results.

Basic components of instruments for analysis

Signal generators, detectors (input transducers) Signal processors, read out devices, circuits & electrical devices in instruments.

References: 1,2,3

2. Sampling Techniques

Terms encountered in sampling: the population or the universe, Sample, Sampling unit, increment, the gross sample, the sub sample, Analysis sample, Bulk ratio, Size to weight ratio, Random sampling, Systematic sampling, Multistage sampling, Sequential sampling. Sampling of Gases, Liquids and Solids Preservation, storage and preparation of sample solution

(References: 1,2,3)

3. Data handling

Significant figures and rounding off. Accuracy and precision

Errors : determinate and indeterminate error, Constant and proportionate errors , Minimization of errors

Standard deviation. Histogram and Frequency polygon

Measures of central tendency and dispersion. Gaussian distribution curve

Confidence limit. Test of significance: F test, Students T

Rejection of the results: Q test, 2.5d & 4d rule.

Linear least squares/ Method of averages

(Numerical problems are expected to be solved)

Reference:1,3

4. Solvent Extraction

Basic principle, percentage extraction, role of complexing agents in solvent extraction, separation factor, Types of extraction (continuous, batch).

(Numerical problems are to be solved)

References: 1,2,3

Section II

5. Electrolytic methods

Introduction: principles involved in Electrogravimetric analysis, Instrumentation, Electrolysis at constant current principle, apparatus, determination of copper by constant current electrolysis.

Coulometry: Introduction, constant Current measuring device, Hydrogen-Oxygen coulometer, Silver coulometer. General characteristics of coulometric method, Coulometric titrations Applications of coulometric titrations *(References: 1,3,)*

Polarography: Introduction, Basic principles of instrumentation of polarography, Deposition potential, Dissolution potential, Polarisation of electrode, Polarographic wave, Ilkovic equation, Half wave equation (derivation not expected) Supporting electrolytes, Interference of oxygen, Applications of polarography – inorganic and organic. *(References: 1,3,5)*

Amperometric titrations: Introduction, Instrumentation, Titration Curves, advantages of amperometric titrations. *(Reference:1,3)*

6. Potentiometric Titrations

Principles of potentiometric titrations, Location of equivalent point, Different types of potentiometric titrations. *(References :1,2,3)*

7. Atomic spectrometric methods:

Flame Photometry: Introduction, Principle, Instrumentation, applications, Limitations. Atomic absorption Spectroscopy: Introduction, Principle, Instrumentation, applications, limitations.

Differences between flame photometry and atomic absorption spectroscopy.

Inducted coupled plasma. *(References: 1,2,3)*

BSED/CHEM 361: Pharmaceutical Chemistry

Section I

1. General Introduction:

Importance of Chemistry in Pharmacy. Definition of terminologies: Pharmacopoeia, Pharmacokinetics, Pharmacodynamics, Pharmacognosy

Dosage forms and Routes of administration. Advantages and disadvantages.

Assay of drugs(an overview): Chemical assay, Biological assay, Immunological assay. Metabolism of drugs: General pathways of drug metabolism. Examples of Phase I reactions like oxidation and reduction, Phase II reactions glucuronic acid conjugation, acetylation. Factors affecting drug metabolism – age, species differences, genetic factors, sex differences.

2. Physico-chemical properties in relation to biological action.

Solubility and partition coefficients, Ionization, Hydrogen bonding, Chelation and Surface activity.

3. Anti-Infective agents:

Definition of each class, structure and use of the following compounds Anti fungal agents – Clotrimazole and Miconazole

Anti viral agents – Amantadine and Acycloguanosine

Anti tubercular agents – Isoniazid and Ethambutol, Synthesis of Ethambutol

Anti protozoals – Metronidazole and Diloxanide furoate

Anthelmintics – Mebendazole and Albendazole

4. CNS Depressants:

Definition of each class, structure and use of the following compounds.

General Anesthetics – Thiopental sodium and Ketamine hydrochloride. Synthesis of thiopental sodium.

Sedative-hypnotics – Phenobarbital and Methaqualone.

Muscle relaxants – Meprobamate and Chlordiazepoxide. Synthesis of chlordiazepoxide. Tranquilizers – Chlorpromazine and Haloperidol. Structure activity relationships of the phenothiazine tranquilizers.

Anti convulsants – Phenytoin and Diazepam.

5. Anti histaminic agents

Definition, causes of allergy. Classification of antihistaminics with structure and uses of the following compounds.

Aminoalkyl ethers – Diphenhydramine

Ethylene diamines – Triprolidine

Propyl amines derivatives – Chlorpheniramine. Synthesis of chlorpheniramine. Phenothiazine derivatives – Promethazine. Synthesis of Promethazine

Piperazine derivatives – Cyclizine

Misscellaneous – Phenindamine and Diphenylpyraline.

Structure-activity relationships of H₁ antagonists.

6. Diuretics

Definition. Classification of diuretics with structure and uses of the following compounds.

Osmotic agents – Mannitol

Mercurials – Mercaptopurine

Phenoxyacetic acids – Ethacrynic acid

Purines and related heterocycles – Theophylline and Triamterene. Synthesis of Theophylline.

Sulfonamides – Acetazolamide and Hydrochlorothiazide
Sulfamyl benzoic acid derivatives – Furosemide

Section – II

7. Analysis of drugs in the solid state:

Concepts of particle size, size distribution shown as cumulative undersize curve.

Thermal Methods of Analysis: Basic principles of Differential Thermal Analysis and Differential Scanning Calorimetry.

Differential thermal analysis – Apparatus and methodology. Factors affecting DTA results, quantitative DTA, interpretation of results.

Applications to detect polymorphism and pseudopolymorphism in pharmaceuticals by DSC or DTA.

8. Fluorimetry

Principles of fluorescence, chemical structure and fluorescence. Relation between concentration and fluorescence intensity.

Spectrofluorometry: Instrumentation (Block diagram), Applications in pharmaceuticals. (*numerical problems to be solved*)

9. Electroanalytical Methods

General Introduction:

Polarography: Basic principles, apparatus and method. Simple manual polarograph (Kolthoff and Lingane), Ilkovic equation, half wave equation (derivation not expected), interference of oxygen, applications of polarography – organic and inorganic

Coulometry: Introduction, current measuring devices, hydrogen-oxygen coulometer, silver coulometer, iodine coulometer. General characteristics of coulometric method, coulometric titrations, detection of end point in constant current coulometry, examples of application of coulometric titrations in pharmaceuticals..

10. Atomic Spectrometric Methods:

Flame Photometry: Introduction, Principle, Instrumentation, applications, Limitations . Atomic

absorption Spectroscopy: Introduction, Principle, Instrumentation, applications, limitations. Differences between flame photometry and atomic absorption spectroscopy. Inducted coupled plasma.

11. Radiochemical Techniques:

Isotope dilution analysis: Principles and applications.

Neutron activation analysis: Principles, advantages and limitations.

Scintillation counters: Body scanning, imaging studies – SCET, PET. Applications using different radiopharmaceuticals.

LABORATORY COURSES

Semester VI

BSEDChem 303: Experiments in Inorganic and Organic Chemistry

INORGANIC CHEMISTRY

(3 Unit students will do only practicals listed under serial no. 1 to 4 below and practicals mentioned on page 17 Sem. VI inorganic chemistry serial no. 1 to 4)

4. Preparation of Sodium trioxalato ferrate(III); $\text{Na}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ complex.

5. Preparation of Trithioureacopper (I) sulphate.
6. Preparation of Trisethylenediaminenickel(II) complex.
- 4 Preparation of Chrome Red.

Gravimetric Estimations

- 5 To estimate the amount of Iron as Fe_2O_3 in the given solution of Ferric chloride containing Barium chloride and free HCl.
- 6 To estimate the amount of Nickel as Ni-DMG in the solution of Nickel chloride

containing Copper chloride and free HCl.

2. To estimate the amount of Barium as BaCrO_4 in the solution of Barium chloride Containing Ferric chloride and free HCl.
3. To estimate the amount of Zinc as $\text{Zn}_2\text{P}_2\text{O}_7$ in the given solution of Zinc sulphate containing copper sulphate and free H_2SO_4 .

ORGANIC CHEMISTRY

(3 unit students will not do any practicals in Organic Chemistry in Sem. V)

Organic Estimations:

- Mixture of acid and ester
- Mixture of acid and amide
- Saponification value of oil

Organic synthesis: Nitration of nitrobenzene and acetanilide, p-bromoacetanilide from Acetanilide, m-nitroaniline from m-dinitrobenzene, synthesis of osazone of glucose and oxime of cyclohexanone.

- v) **Finding the organic mixture type: Solid-solid-Water Soluble- Insoluble type.**
1) Acid-Acid 2) Acid-Neutral 3) Neutral-Neutral
Liquid-liquid mixture type as well as the separation.

Note: 1) 6 Organic Synthesis to be completed in 3 practicals.

2) At least 5-6 mixture type determination to be given (not to be given for examination)

SYLLABUS OF B.Sc. B.Ed (BOTANY)

Implemented from the Academic Year 2011-12

A brief description of the programme:

- 25) **Purpose:** Plants being primary producers form the basis of the existence of all other forms of life. As they provide food, feed, shelter, medicines, etc., study of plants is fundamental to harnessing their potential. In fact environmental and ecological health of a country is indexed based on plant wealth. But at the same time, deforestation is wiping out the diversity at an alarming rate. Fortunately, new tools and technological innovations come handy in handling these problems. In the present under graduate programme of Botany, all the aspects of plant sciences, right from diversity and classification to molecular biology and genetic engineering is covered to equip young graduates to i) appreciate the enormous diversity in plant kingdom, ii) understand their ecological, economical and livelihood role, iii) understand various functioning at physiological and molecular level and iv) manipulate these organisms to harness the benefits to human community. Understanding these are pivotal to the very existence of human species, and hence training our graduates and equipping them for the future challenges is of paramount importance.
- 26) **Prerequisites:** Higher Secondary with Biology background.
- 27) **Papers:** Totally 16 papers will be taught in Botany spreading three years to get a degree in Botany. Those who opt for three units will take 4 papers less in Third year.
- 28) **Number of semesters, how the courses are distributed:** Total of Six Semesters in Three years. During the First Year and Second Years two papers in each semester will be taught. In the Third Year, 4 papers in each semester will be taught.
- 29) **Project work:** Students have to undertake a project work either singly or in groups during the Third Year.
- 30) **Field work:** Field work forms an important and interesting component. The number of field visits and duration of field work increases as the students graduate from First year to next levels.

B. Sc. B.Ed.(Botany) List of Papers

Description of papers appears on the page number listed in the tables.

Paper Number and Title
First year - Semester I:
BSEDBOT 101 - Diversity and Classification of Plant Kingdom-I
BSEDBOT 102 - Cell biology
First year - Semester II:
BSEDBOT 201- Diversity and Classification of Plant Kingdom-II
BSEDBOT 202- Principles of Biochemistry
Second year Semester III:
BSEDBOT 301- Plant Physiology-I
BSEDBOT 302- Plant Ecology -I
Second year Semester IV:
BSEDBOT 401- Plant Physiology-II
BSEDBOT 402- Plant Ecology – II
Third year Semester V:
BSEDBOT 501 - Systematics of Angiosperms
BSEDBOT 502- Genetics & Plant Breeding
Third year Semester VI:
BSEDBOT 601- Plant Biochemistry & Molecular Biology
BSEDBOT 602 - Plant Biotechnology & Genetic Engineering
Fourth year Semester VII:
BSEDBOT 701- Plant Anatomy and Developmental Biology of Flowering Plants
BSEDBOT 702- Genetics, Plant Breeding and Statistical Methods
Fourth year Semester VIII
BSEDBOT 801- Microbiology & Plant Pathology
BSEDBOT 802- Economic & Applied Botany
Field work (all the three years)
Fourth year <i>(The following papers are for 3 Unit students)</i>
Semester V:
BSEDBOT 501 - Systematics of Angiosperms
BSEDBOT 502 - Genetics & Plant Breeding
Semester VII:
BSEDBO T 701 - Plant Anatomy and Developmental Biology of Flowering Plants
BSEDBOT 802- Economic & Applied Botany

F.Y. B.Sc. (Botany): (effective from 2011-12)
(Semester I):

BSEDBOT 101: DIVERSITY AND CLASSIFICATION OF THE PLANT KINGDOM - I

Theory:

Plant kingdom: Classification of kingdoms and the criteria (according to Meyer, the seven kingdoms, of living organisms); Prokaryotes and Eukaryotes; diversity in habitat, form (Habit), life span, nutrition and ecological status; origin, evolution and phylogeny of land plants; extinctions and possible causes; fossils and living fossils (a brief account).

Algae: Origin, evolution, diversity, general characters, classification *of all groups and phyla* (Bold & Wynne), range of thalli and reproductive structures and life cycles **(of all the types)** with minimum one example each, ecological, economic and biotechnological significance.

Fungi: Origin, evolution, diversity, general characters, nutritional modes, classification (G.C. Ainsworth), range of vegetative and reproductive structures, pleomorphism and parasexuality, important features of Mastigomycotina -*Pythium*,; Zygomycotina -*Mucor*; Ascomycotina -*Saccharomyces*, *Peziza*; Basidiomycotina - *Puccinia*, *Agaricus*; Deuteromycotina -*Cercospora*, general account of Lichens and Mycorrhizae; ecological, economic and biotechnological significance of fungi.

Bryophytes: Origin, evolution, diversity, general characters, classification (G.M.Smith) and comparative study of morphology, anatomy, reproduction; broad interrelationships of Hepaticae, Anthocerotae and Musci; ecological and economic importance of bryophytes.

Laboratory Exercises:

1. Study of prokaryotic organisms: bacteria (*Bacillus*, *Staphylococcus*, *Streptococcus*, *Spirillum*); Monochrome and Gram's staining; Blue green algae -*Anabaena*, *Oscillatoria*
13. Study of eukaryotic organisms:
 - a. Algae: *Chlorella*, *Chlamydomonas*, *Volvox*, *Hydrodictyon*, *Spirogyra*, *Oedogonium*, *Cladophora*, *Chara*, *Sargassum*, *Ectocarpus*, *Polysiphonia*. (permanent specimen can be shown and a few can be freshly prepared)
 - b. Fungi: *Rhizopus*, *Aspergillus*, *Saccharomyces*, *Penicillium*, *Chaetomium*, *Peziza*, *Agaricus*; lichen, mycorrhizae
 - c. Study of morphology, anatomy and reproductive structures in *Riccia*, *Marchantia*, *Anthoceros*, *Funaria*.

BSEDBOT 102: CELL BIOLOGY

Theory:

The Cell: Historical background; cell theory; kingdom-wise cell size and cell structure; viroids and prions; comparative account of prokaryotic and eukaryotic cell; characteristics of archaeobacteria, mycoplasma, MLO and PPLO.

Cell division and its regulation: Mitosis and meiosis -historical perspective and significance; various stages of cell division progression; cytokinesis; role of centromere, telomere, kinetochore and spindle apparatus; animal and plant cell cycle; mechanisms of cell cycle control; **apoptosis**.

Nucleus and Ribosomes: Ultrastructure; nuclear envelope and nuclear pore complex; nuclear matrix and nucleoplasm; DNA, RNA and histones; nucleosome and higher level of organization; ribosome structure; prokaryotic, eukaryotic and organelle ribosomes and their functional significance.

Mitochondrion and Chloroplast: Origin of organelles; organelle structure and biogenesis; organelle membranes and organization of macromolecular complexes; variation in size, shape and number; types of plastids; organelle-nuclear interactions; organelle genome organization.

Structure/function of other Sub-cellular structures: Golgi complex; endoplasmic reticulum; lysosomes; microbodies - peroxisomes and glyoxysomes; cytoskeleton and microtubules.

Cellwall and Cell membranes: Origin, ultrastructure, chemical constituents and functions of cell wall; models of cell membrane organization; role of various membrane proteins, lipids, carbohydrates and lectins; role of ion channels and pumps in cellular transport and signalling.

Techniques in Cell biology: Principles and applications of light, phase contrast, fluorescence and electron microscopy (SEM & TEM); micrometry and cell fractionation procedures

Laboratory Exercises:

1. Comparative study of cell structure in onion cells, *Hydrilla* and *Spirogyra*. Study of cyclosis in *Tradescantia* staminal hairs.
2. Examination of EM graphs of prokaryotic and eukaryotic cells.
3. Study of various stages of mitosis and meiosis using appropriate plant material (e.g. root tips and flower buds of onion).
4. Isolation of chloroplasts from leaf material using gradient centrifugation and visualization under microscope
5. Micrometry, camera lucida and cytometry (size measurements)
6. Study of plastid types using microscope.
7. Histo-chemical test for cellulose, lignin, chitin and suberin in sections
8. Study and working of microscopes, centrifuges, microtomes,
9. Visit to the facilities of Department of Botany, Goa University (optional)

BSEDBOT 201: DIVERSITY & CLASSIFICATION OF THE PLANT KINGDOM - II

Theory:

Pteridophytes: Salient features of primary vascular plants; classification (Foster & Gifford), comparative study of morphology, anatomy, reproduction; stelar evolution; a general account of evolutionary significance of Psilopsida-, Lycopsida-, Sphenopsida- and Pteropsida-; heterospory and seed habit; economic importance.

Gymnosperms: Classification (Coulter and Chamberlain) and salient features; evolutionary significance of gymnosperms; comparative general study of morphology, anatomy and reproduction of Cycadales, Coniferales and Gnetales; economic importance.

Angiosperms: Unique features of angiosperms and diversity; identification, nomenclature and classification; comparison of systems of classification (Bentham & Hooker and Engler & Prantl); primitive and advanced features; salient features of the International code of Botanical Nomenclature; general account of morphology, anatomy, flower structure, reproduction and seed development.

Laboratory Exercises:

1. Study of morphology, anatomy and reproductive structures by sectioning (*Selaginella*, *Equisetum*, *Salvinia*,) and using permanent slides (*Psilotum*, *Lycopodium*, *Pteris*, *Lepidodendron*, *Lepidocarpon*).
2. Study of morphology, anatomy and reproductive structures in *Cycas*, *Pinus*, *Gnetum*
11. A study of the representative members of the following angiosperm families: Magnoliaceae, Leguminosae (Papilionoideae, Caesalpinoideae, Mimosoideae), Umbelliferae (Apiaceae), Compositae (Asteraceae), Acanthaceae, Euphorbiaceae, Liliaceae, Graminae (Poaceae). (Bentham & Hooker's Classification)
4. Study of tissue types (permanent slides to be shown).

BSEDBOT 202: PRINCIPLES OF BIOCHEMISTRY

Theory:

Cellular chemistry: Bioelements and biomolecules; chemical bonds, interactions and their significance; peptide bonds, disulphide bonds, structure, properties of water and its biological significance; pH, inorganic and biological buffers and their significance

Biomolecules: Essential and non-essential elements; structure, classification and properties of amino acids, carbohydrates, lipids, proteins and Nucleic acids; primary and secondary metabolites, **Isomerism**

Energy flow: Laws of thermodynamics; concept of free energy; energy transfer and redox potential; ATP -the energy currency; phosphorylation / dephosphorylation of proteins

Enzyme structure, classification and functions: enzymes as biocatalysts; classification and nomenclature of enzymes; physico-chemical properties of enzymes; cofactors and coenzymes; isozymes, kinetics of enzyme action; significance of K_m ; mechanism of enzyme activity; factors affecting enzyme activity, e.g. temperature, pH; allosteric modification and feedback regulation

Techniques in biochemistry: Simple chemical detection techniques for biomolecules, principles of various chromatographic, electrophoretic and spectrophotometric techniques

Laboratory Exercises:

1. Preparation of chemical reagents (molar, molal and normal solutions) and buffers
2. Measurement of pH of different plant extracts (C3, C4 and CAM plants)
3. Qualitative analysis of biomolecules (amino acids, proteins and carbohydrates)
4. Chlorophyll separation and anthocyanin separation using paper chromatography.
5. Estimation of proteins by Lowry's method
6. Micro-chemical detection of reducing sugars in floral nectar using Benedict's reagent
7. Determination of pKa value of amino acids (Glycine/glutamic acid)
8. Study of amylase activity (substrate base). Effect of pH and temperature on the activity of amylase
9. Determination of acid value of fat
10. Estimation of RNA by means of orcinol reaction
9. Visit to the facilities of Department of Botany, Goa University

Suggested Readings (Paper I & III):

- 13) Bold, H.C., Alexopoulos, C.J. and Delevoryas, T. 1980. Morphology of Plant and Fungi (J,n Edition). Harper and Foul Co., New York.
- 14) Bold H.C. and Wynne M.J. 1978. Algae-Structure and Reproduction.Prentice hall Englewood cliffs, New Jercey.
- 16) Clifton, A. 1985. Introduction to the Bacteria. McGraw Hill Co., New York.
- 17) Chamberlain C.J. 1986.Gymnosperms structure and evolution . C.B.S. publishers and distributors.
- 18) Chapman V J. and Chapman D.J. 1975. The algae. 2nd edition. Mac.Millan Publ. Inc. New York.
- 19) Chapman V J. and Chapman D.J.1980. Seaweeds and their uses 3-rd edition.
- 20) Dodge J.D. 1973.The fine structure of algal cells, Acadameic press New Delhi.
- 21) Dube, H.C. 1990. An Introduction to Fungi. Vikas Publishing House Ltd., Delhi.
- 22) Fritsch F.E.(1935,45). The structure and reproduction of algae Vol.I and II, University press Cambridge
- 23) Gangulee and Kar, College BotanyVol.I and II.
- 24) Gifford, E.M. and Foster, A.S. 1989. Morphology and Evolution of Vascular Plants.
- 25) Kumar, H.D. 1988. Introductory Phycology. Affiliated East:-West Press Ltd., NY.
- 26) Mandahar, C.L. 1978. Introduction to Plant Viruses. Chand & Co. Ltd., New Delhi.
- 27) Parihar N.S. 1967. An introduction to Bryophyta
- 28) Parihar N.S.1967. An introduction to Pteridophyta.
- 29) Prescott G.W. 1981.Algae- A Review.
- 30) Puri, P. 1985. Bryophytes. Atmaram & Sons, Delhi, Lucknow.
- 31) Rashid A. 1986. An introduction to Pteridophytes. Vani educational Book.N.D.C.
- 32) Raven, P.H., Evert, R.F. and Eichhorn, S.E. 1999. Biology of Plants (Sh edition). W.H. Freeman & Co., Worth Publ., New York, USA.
- 33) Smith G.M. 1955.Cryptogamic Botany Vol.I and II. Algae and Fungi, 2nd Edition, Mc Graw Hill, New York.
- 34) Sporne, K.R. 1991. The Morphology of Gymnosperms. B.I. Publications Pvt., Bombay, Calcutta, Delhi.
- 35) Sundarajan ,College Botany, Vol.I and II.
- 36) Wilson, N.S. and Rothwell, G. W. 1993. Palaeobotany and the Evolution of Plants ('2nd Edition). Cambridge University Press, UK.
- 37) Vasishta B.R. 1988. Algae S.Chand and Company New Delhi.
- 38) Webster J. (1970). Introduction to Fungi. .Cambridge University Press, New York.

Suggested Readings (Paper II & IV):

- 15) Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. Molecular Biology of Cell. Garland Publishing Co., Inc., New York, USA.
- 16) Avers, C.J. 1986. Molecular Cell Biology. Addison-Wesley Publishing Co., Massachusetts, USA.
- 17) Campbell, M.K. 1999. Biochemistry (Jd Edition). Saunders College Publishing, Philadelphia.
- 18) Gupta, P.K. 1999. A Text-book of Cell and Molecular Biology. Rastogi Publcatons, Meerut, India.
- 19) Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology ('2d Edition). Harper Collins College Publishers, New York, USA.
9. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology (1,' Edition). W.H. Freeman and Co., New Yqrk, USA.
10. Nelson, D.L. and Cox, M.M. 2000. Lehninger Principles of Biochemistry (3d Edition).

- Worth Publishers, New York, USA.
11. Rawn, D.J. 1989. Biochemistry. Neil Patterson Publishers, North Carolina, USA.
 12. Stryer, L. 1995. Biochemistry. W.H. Freeman and Co., New York, USA.
 13. Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA.
 14. Zubay, G. 1993. Biochemistry (3d Edition). WCB Publishers, Iowa, USA.

Suggested Readings (for laboratory exercises):

1. Dryer, R.L. and Lata, G.F. 1989. Experimental Biochemistry. Oxford University Press, New York.
22. Gunning, B.E.S. and Steer, M.W. 1996. Plant Cell Biology: Structure and Function. Jones and Bartlett Publishers, Boston, Massachusetts.
23. Harris, N. and Oparka, K.J. 1994. Plant Cell Biology: A Practical Approach. IRL Press, at Oxford University Press, Oxford, UK.
24. Ninfa, A.J. and Ballou, D.P. 1998. Fundamental Laboratory Approaches for Biochemistry and Biotechnology. Fitzgerald Science Press, Inc., Maryland, USA.
25. Wilson, K. and Goulding, K.H. (Eds.) 1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London, UK.

SY B.Sc. (Botany): (effective from 2012-13)
(Semester III):

BSEDBOT 301. PLANT PHYSIOLOGY -I

Theory:

Plant-water relations: Water transport processes; diffusion and osmosis; water potential and chemical potential; absorption of water, water transport through tracheids and xylem (ascent of sap); transpiration and its significance; factors affecting transpiration; mechanism of stomatal movement, root pressure, guttation, imbibition, mass flow, antitranspirant.

Mineral nutrition: Criteria of essentiality of elements; macro- and micronutrients; role of essential elements; mineral deficiency symptoms and plant disorders; nutrient uptake and transport mechanisms; role of cell membrane, ion pumps and carriers.

Photosynthesis: Historical background and significance; structure of photosynthetic apparatus; photosynthetic pigments; accessory pigments and the photoprotective carotenoids; reaction center complexes; photochemical reactions; electron transport pathways in chloroplast membranes; photophosphorylation; the Calvin cycle; the C4 carbon cycle; crassulacean acid metabolism; synthesis of starch and sucrose; photorespiration; factor affecting photosynthesis.

Transport of organic substances: Transport of photosynthates; source-sink relationship; the mechanism of translocation in the phloem; assimilate partitioning.

Laboratory Exercises:

1. Measurement of Relative water content (RWC) of plant tissue.
2. To extract and separate photosynthetic pigments by paper chromatography
3. Spectral analysis of pigment (to determine B-carotene, Chl a and chl b and other carotene)

- bands) separated by above paper chromatography method
4. Determination of chlorophyll a and total chlorophyll in shade and sun plants.
 5. Photo-oxidation of photosynthetic pigments.
 6. To determine the osmotic potential of vacuolar sap by plasmolytic method,
 7. To determine the water potential of given tissue (any tuber).
 8. To determine stomatal index, stomatal frequency and percentage of leaf area open through stomata.
 9. Anatomical feature of C3 and C4 plants.
 10. Nutrient deficiency symptoms. Hydroponically (*Demonstration only*).
- A visit to ICAR (Ela Farm) (**optional**)

BSEDBOT302: PLANT ECOLOGY I

Theory:

Introduction: Definition; holocoenotic nature of environment; limiting factors; ecological amplitude; triggering factors (soil, water, atmosphere); inter-relationships between the living world and the environment; the components and dynamism; homeostasis; relevance to man.

Earth as a system: The biosphere, the hydrosphere, the atmosphere and the lithosphere; Gaia hypothesis; structural and functional components of systems; Biomes - parameters delimiting individual biomes.

The environment and Ecological adaptations: Soil, water and atmosphere -general account and adaptations; the living world -biotic component of environment; types of biotic interactions; Concept, ecads, ecotypes and ecoclines; adaptive significance of photosynthetic pathways.

Ecosystem: Concept, components (abiotic and biotic) and organization; structure and functions; homeostasis; energy flow - models; productivity; food chain and food web; trophic organization and ecological pyramids; autotrophy, heterotrophy, parasitism and saprophytism; Biogeochemical cycles - sedimentary (P), gaseous (C, N) and hydrological cycles.

Diversity of ecosystems: Aquatic, terrestrial and manmade (agricultural). Ecosystems of Goa - Wetlands, Mangroves, Coastal Ecosystems, Sand dunes, Forests.

Organismal ecology/biotic components: Introduction to individuals, species, populations and communities.

Laboratory Exercises:

24. To determine the working and use of instruments for the measurement of temperature (soil, air, water), moisture (rainfall, relative humidity, soil moisture), wind (velocity and direction) and light intensity.
- 7) To study selected soil properties by spot test: texture, pH, carbonate, nitrate, base deficiency and reductivity and water holding capacity.
3. Titrimetric estimation of total carbonates of soil samples.
13. Analysis of different water samples for pH, oxygen, carbon-dioxide (titrimetric estimation),

- turbidity and temperature.
- * To study ecological adaptations (morphological and anatomical) in plants (hydrophytes, xerophytes, epiphytes).

SYBSc (Botany)

(Semester IV):

BSEDBOT 401: PLANT PHYSIOLOGY II

Theory:

Respiration: Glycolysis; the TCA cycle and its regulation; electron transport in mitochondria; oxidative phosphorylation; pentose phosphate pathway; cyanide-resistant respiration; ATP synthetase.

Nitrogen metabolism: Biological nitrogen fixation; reduction of N_2 into ammonia; *nif* genes; regulation of nitrate reductase and nitrogenase; nitrate and ammonium assimilation; Pyridoxal phosphate.

Growth and development: General aspects -definitions, phases of growth; kinetics of growth; physiology of seed dormancy and seed germination; concept of photoperiodism; physiology of flowering; the florigen concept and its role. Photomorphogenesis; discovery of phytochromes and cryptochromes, their role and mechanism of actions. Vernalization; fruit-ripening; importance of respiratory climacteric.

Growth Regulators: Discovery, physiological role and mechanism of action of the phytohormones -auxins, cytokinins, gibberellins, abscisic acid and ethylene.

Plant movements -tropic and nastic; biological clocks.

Stress physiology: In relation to drought, salt, metals and radiations

Secondary metabolites: Terpenes, phenols, tannins and alkaloids (biosynthesis and uses).

Laboratory Exercises:

1. Qualitative detection of α-amylase, lipase, acid phosphatase, catalase, peroxidase.
2. Estimation of nitrate reductase.
3. Extraction and spectral analysis of phycocyanin from BGA and spectral.
3. Quantitative estimation of A.A. by ninhydrin methods..
4. Extraction and separation of flavonoids using paper chromatography (2 P) and demonstration of 2D with the same plate.
4. Comparative study of rate of respiration of various plant parts.
5. Role of light in germination of photoblastic seeds, Spinach/tomato.
6. Bioassay of plant hormones -auxins, GA, and cytokinin.
7. Determination of IAA oxidase activity.

Suggested Readings (Paper V & VII)

- 15) Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag., New York, USA.
- 16) Hooykaas, P.J.J., Hall, M.A. and Libbenga, K.R. (eds) 1999. Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam, The Netherlands.
- 17) Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
- 18) Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2'd edition). Springer-Verlag, New York, USA. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology (4h edition). Wadsworth Publishing Co., California, USA.
- 19) Taiz, L. and Zeiger, E. 1998. Plant Physiology (1'd edition). Sinauer Associates, Inc., Publishers, Massachusetts USA.

Suggested Readings (for laboratory exercises)

14. Copeland, R.A. 1996. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis. VCH Publishers, New York.
15. Dryer, R.L. and Lata, G.F. 1989. Experimental Biochemistry. Oxford, Univeristy Press, New York.
16. Moore, T.C. 1974. Research Experiences in Plant Physiology: A Laboratory Manual. Springer-Verlag, Berlin.
17. Wilson, K. and Goulding, K.H. (Eds.) 1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London, UK.

BSEDBOT 402: PLANT ECOLOGY II

Theory:

Community: Community characteristics, Structure (vertical and horizontal), climax types and theories; niche concept, succession and types. Measurement of communities: species diversity (alpha, beta and gamma); quantitative ecology - sampling methods (quadrats, transects, bisects), frequency, density, abundance and Importance Value Index (IVI); species diversity indices; vegetation mapping.

Population: Concepts; population characteristics; density and pattern; idealized plant life history; population growth; carrying capacity; population regulation and population dynamics; r- and K-selection; population interactions.

Phytogeography: General principles; static and dynamic plant geography; continental drift, age and area hypothesis, land bridge theory; endemism - types and causes; biodiversity hotspots - Eastern Himalayas and Western Ghats; vegetation types of India; vegetation types of Goa.

Human ecology and ecological management: Human population; renewable and non-renewable natural resources and their management; conservation of biodiversity, endangered species; conventional and non-conventional energy sources.

Remote Sensing and GIS in Ecological Applications: Remote Sensing - Definition; Electromagnetic radiation and atmospheric windows; EMR and reflectance from vegetation; satellites and satellite remote sensing; application of RS in ecology, forestry, agriculture and

environment; GIS - Principles; application of GIS in biodiversity, ecological, environmental spatial management.

Role of Governmental and Non-Governmental organizations in environmental management: National- Ministry of Environment and Forests, NEERI, TERI, CEE, CHIPKO, MSSRF; International - WWF, IUCN, UNEP, MAB, CITES, TRAFFIC, Green Peace

Laboratory Exercises:

19. To determine minimum area of sampling unit (quadrat) for the study of grassland community.
2. Analysis of the herbaceous vegetation for frequency, density and abundance.
10. Species diversity indices (Simpson's & Shannon-Weiner) of herbaceous vegetation.
11. Estimation of biomass of aerial parts of herbaceous plants (fresh weight and dry weight).
18. To prepare maps of India with respect to (i) major climatic zones (ii) forest types, and (iii) biogeographical regions and to comment on it. Use of google earth
6. Visual interpretation of remotely sensed image for vegetation types
7. Soil analysis for organic content by titration.
8. Soil and water analysis for total phosphorus by spectrophotometric methods
9. Identification and density count of phytoplankton using hemacytometer .

Suggested Readings (Paper VI & VIII)

18. Ambasht, R.S. 1988. A Text Book of Plant Ecology. Students Friends Co., Varanasi.
19. Barbour, M.G., Burk, J.H. and Pitts, W.O. 1987. Terrestrial Plant Ecology.
20. Benjamin/Cummings Publication Cc California.
21. Botkin, D.B. and Keller, E.A. 2000. Environmental Planet (3rd edition). John Wiley & Sons Inc., New York.
22. Chapman, J.L. and Reiss, M.J. 1995. Ecology: Principles and Applications. Cambridge University Press.
23. Cunningham, W.P. and Saigo, S.W. 1997. Environmental Science: A Global Concern. WCB, McGraw Hill.
24. Dash, M.C. 1993. Fundamentals of Ecology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
25. Daubenmire, A.F. 1974. Plants and Environment -A Text Book of Plant Ecology (3^d edition). John Wiley & Sons, New York.
26. Hill, M.K. 1997. Understanding Environmental Pollution. Cambridge University Press. India Pvt. Ltd., New Delhi.
27. Kendeigh, S.C. 1980. Ecology with Special Reference to Animals and Man. Prentice Hall of India Pvt. Ltd., New Delhi.
28. Kormondy, E.J. 1996 (4th Ed.). Concepts of Ecology. Prentice Hall of India Pvt. Ltd., New Delhi.
29. Kumar, H.D. 1996. Modern Concepts of Ecology (4^h edition). Vikas Publishing House Pvt. Ltd., Delhi.
30. Kumar, H.D. 1997. General Ecology. Vikas Publishing House Pvt. Ltd., Delhi.
31. Mackenzie, A. et al. 1999. Instant Notes in Ecology. Viva Books Pvt. Ltd., New Delhi.
32. Miller, W.A. and Donahue, A.L. 1992. Soils ~ An Introduction to Soil and Plant Growth (6^h edition). Prentice Hall
33. Odum, E.P. 1983. Basic Ecology. Saunders, Philadelphia.
34. Odum, E.P. 1996. Fundamentals of Ecology. Natraj Publishers, Dehradun.
35. Pickering, K.T. and Owen, L.A. 1997. An Introduction to Global Environmental Issues (2^d edition). Butter and Tanner Ltd., Great Britain.
36. Smith, L.A. 1996. Ecology and Field Biology (Sh edition). Harper Collins College Publishers, USA.

37. Smith, L.A. and Smith, T.M. 1998. Elements of Ecology (4th edition). An Imprint of Addison Wesley, Longman Ink., California.
38. Tyler, M.G., Jr. 1997. Environmental Science: Working with Earth (6th edition). Wadsworth Publishing Co.
39. Weaver, J.E. and Clements, S.E. 1966. Plant Ecology. Tata McGraw Publishing Co. Ltd., Bombay.

Suggested Readings (for laboratory exercises)

- 8) Ambasht, R.S. 1990. Environment and Pollution. Students Friends and Co. Varanasi, India.
- 9) APHA - Standard Methods for the Examination of Water and Waste Water. American Public Health Association, Washington, D.C.
- 10) Kapur, P. and Govil, S.R. 2000. Experimental Plant Ecology. S.K. Jain for CBS Publishers and Distributors, New
- 11) Misra, R. 1968. Ecology Work Book. Oxford and IBH. New Delhi.
- 12) Moore, P.W. and Chapman, S.B. 1986. Methods in Plant Ecology. Blackwell Scientific Publication.
- 13) Moore, P.W. and Chapman, S.B. 1986. Methods in Plant Ecology. Blackwell Scientific Publications.
- 14) Piper, C.S. 1950. Soil and Plant Analysis. University of Adelaide, Australia.
- 15) Smith, R.L. 1966. Ecology and Field Biology. Harper Collins, New York.
- 16) Smith, R.L. 1990. (4th edition). Ecology and Field Biology. Harper Collins, New York.
10. Smith, R.L. 1996. Ecology and Field Biology. Harper Collins, New York.

T.Y. B.Sc. (Botany): (effective from 2013-14)

Semester V

BSEDBOT 501: SYSTEMATICS OF ANGIOSPERMS

Theory:

Introduction: Aims, scope and components of systematics; introduction to identification, nomenclature, phylogeny and classification.

Systematics in practice: Importance of herbarium specimens and their preparation; role of herbaria and botanical gardens; documentation (Floras, monographs, manuals, journals, abstracts, indices and dictionaries); keys for identification of plants -single access and multi access; value of computers and databases for identification.

Taxonomic hierarchy: Taxonomic category; taxonomic groups; concepts of species, genus and family.

Botanical nomenclature: ICBN - Principles and rules; ranks and names; type method; principle of priority and its limitations; names of hybrids and cultivars.

Origin and evolution of angiosperms: A general account of the origin and evolution of angiosperms (special reference to Bennettitalean, Gnetalean, Caytonialean and herbaceous origin theories); primitive living angiosperms; evolution of flower; co-evolution of flowers and insects.

Systems of classification: Hutchinson's, Cronquist's systems of classification.

Evidence from other fields: Supporting evidences/inputs for taxonomy; evidences from Anatomy, embryology, palynology, ecology, cytology, secondary metabolites and semantides.

Numerical taxonomy and cladistics: Concepts, characters, methods, dendrograms / cladograms and their interpretation and applications.

Systematic position, diagnostic features and important species of following families:

Annonaceae, Capparidaceae, Brassicaceae, Tiliaceae, Rutaceae, Myrtaceae, Cucurbitaceae, Rubiaceae, Apocyanaceae, Asclepiadaceae, Solanaceae, Verbenaceae, Lamiaceae, Amaranthaceae, Moraceae, Orchidaceae, Araceae, Palmae, Zingiberaceae, Commelinaceae.

Laboratory Exercises:

1. Phytography
2. Use of taxonomic keys and construction of dichotomous keys
3. Preparation of herbarium of one terrestrial plant.
- n) Identification of all the families (Bentham & Hooker's system) studied in theory should be taught from locally available specimens (with floral diagram).
5. Taxonomic interpretation of pollen of related species
6. Raphides/Cystoliths in related sp/genera

Suggested readings:

- vi) Davis, P.H. and Heywood, V.H. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
- vii) Heywood, V.H. and Moore, D.M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
- viii) Jones, S.B., Jr. and Luchsinger, A.E. 1986. Plant Systematics (2'd edition). McGraw-Hill Book Co., New York. Lawrence, G.H.M. 1951. Taxonomy of Vascular Plants. MacMillan, New York.
- ix) Naik, V.N. 1984. Taxonomy of Angiosperms. Tata McGraw Hill, New Delhi.
- x) Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper and Row, New York.
- xi) Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi.
- xii) Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge, London.
- xiii) Stace, C.A. 1989. Plant Taxonomy and Biosystematics, 2'd ed. Edward Arnold, London.
- xiv) Woodland, D. W. 1991. Contemporary Plant Systematics. Prentice Hall, New Jersey.

BSEDBOT 502: GENETICS AND PLANT BREEDING

Theory:

Mendelian genetics and principles of inheritance: Mendel's experiments; backcross and test cross; gene interactions and modified dihybrid ratios - complementary, supplementary, duplicate and epistatic factors.

Multiple allelism: Multiple alleles in *Drosophila* (eye colour), man (blood groups) and plants (self incompatibility).

Quantitative genetics: Quantitative traits and quantitative genetics; the multiple factor hypotheses.

Linkage and recombination: Coupling and repulsion phases; two and three point test cross with their significance in chromosome mapping; interference and co-efficient of coincidence.

Cytoplasmic inheritance and Maternal influence: Kappa particles in *Paramecium*; CO₂ sensitivity in *Drosophila*; Plasmids in Bacteria; cytoplasmic inheritance in yeast (mitochondria) and *Mirabilis jalapa* (plastids); chemical basis of cytoplasmic inheritance; Shell coiling in snails; eye color in flour moth.

Sex chromosomes in *Drosophila*, Man and *Melandrium*: Balance concept of sex determination in *Drosophila*; mechanisms of sex determination; sex-linked inheritance in *Drosophila* and man; sex-limited characters.

Plant breeding: Introduction, history, objectives, achievements and prospects; genetic variability and its role in plant breeding; centres of origin of crop plants; organizations- ICAR, ICRISAT.

Breeding for disease resistance: Physiological races and path types; genetics of pathogenecity; vertical and horizontal resistance.

Plant breeders' rights; Phytosanitary and seed certifications.

Laboratory Exercises:

- x) Determination of chromosome count from dividing pollen mother cells (meiosis) (*Allium cepa* / *Rheo bicolor*), root tip (Mitosis) in *Allium cepa*.
- 2. Preparation of karyotypes from dividing root tip cells.
- vi) Determination of interspecific variation in chromosome number from locally available taxa (*Amorphophallus*/ *Urginea indica*).
- i) Identification of sex chromosomes and their behaviour during meiosis from grasshopper and any appropriate dioecious plant (*e.g. Coccinia*).
- I Detection of anomalies in chromosome pairing and disjunction caused by mutagens and structural alterations of chromosomes in *Rheo bicolor* / *Setcretia sp.*

T.Y. B.Sc. (Botany): Semester VI

BSEDBOT 601: PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY

Theory:

Carbohydrate metabolism: Introduction to glycobiology; plant lectins; biosynthesis and degradation of sucrose, cellulose and starch; bioconversion of carbohydrates to bioethanol.

Lipid metabolism: Structure and function of membrane lipids; fatty acid biosynthesis; oxidation of fatty acids; storage and mobilization of fatty acids and lipids; liposomes; PUFA.

Vitamins: Chemistry and biological functions of Vitamin A, B complex, C, D, E, P and K; occurrence in plants.

Immunochemistry: Type of antigens, immunoglobulins and antibodies, antigen-antibody interactions, biological activities of antibodies; edible vaccines.

Nucleic acids: Composition of nucleic acids and synthesis of nucleotides; Central and revised Dogma of molecular biology. DNA structure; A,B,C,D and Z forms of DNA; denaturation and renaturation of DNA; chromatin structure; DNA replication and recombination; DNA polymerases; different forms of RNA and their role; RNA silencing.

Amino acid and protein metabolism: Essential amino acids; amino acid biosynthesis; Transamination; peptide bond and polypeptide chain; structure and function of ribosomes; protein biosynthesis and its regulation; post-translational modification of proteins; protein folding and transport; protein secretion and degradation.

Gene structure, expression and regulation: Gene organization in prokaryotes and eukaryotes; operon concept; gene regulation in prokaryotes and eukaryotes; inducible, repressible, positive and negative gene regulation; interrupted genes in eukaryotes; RNA splicing; mRNA stability.

Laboratory exercises:

1. Estimation of reducing sugars by DNSA method.
2. Estimation of total sugars using phenol-sulphuric acid method.
3. Localization of carbohydrates using I₂KI and PAS.
4. Localization of lipids using Sudan III.
- A To identify the amino acids in a mixture of standards by resolving through TLC.
6. Isolation and estimation of total RNA (orcinol method) from plant tissue.
7. Isolation and estimation of plant DNA using diphenyl amine method.
8. Estimation of Ascorbic Acid.
9. Separation of protein by SDS-PAGE (casting of gel, sample preparation, running of gel and development of gel)
10. Preparation of agarose gel and running of DNA
11. Estimation of vitamin A in different plant tissue

BSEDBOT 602: PLANT BIOTECHNOLOGY AND GENETIC ENGINEERING

Theory:

Plant biotechnology: Concept and scope - an overview.

Laboratory organization and techniques in Plant Tissue Culture: Tissue culture laboratory; culture media, media preparation, aseptic transfer.

Concept of differentiation: Cellular differentiation and totipotency; effect of growth regulators on differentiation; callus and suspension culture; somaclonal variation; meristem culture, anther and pollen culture, embryo culture, organogenesis and embryogenesis.

Somatic hybridization: Protoplast isolation, fusion and culture; immobilization and synthetic seeds; cybrids.

Recombinant DNA technology: Restriction endonucleases, ligases, methylases; prokaryotic and eukaryotic cloning vectors; genomic and cDNA libraries; Southern, northern and western analysis; various techniques DNA fingerprinting (RFLP, RAPD, AFLP); polymerase chain reaction; DNA isolation and sequencing.

Genetic engineering of plants: Introduction; selectable markers and reporter genes; methods of gene delivery (*Agrobacterium and gene gun*); hairy-root culture; **Plastid transformation**, salient achievements in crop biotechnology (with suitable transgenic examples) and prospects.

Plant genomics and bioinformatics: *Arabidopsis* and rice genome; bioinformatics: introduction; scope and application in plant genomics.

Bio-energy and bioremediation: Composition of biomass, methods of energy production, methane, bioethanol, petroplants - *Jatropha* and biodiesel. Bioremediation of waste water and polluted soils by plants.

Proteomics, metabolomics and functional genomics

Laboratory exercises:

- Preparation of tissue culture media (carrot culture), sterilization and inoculation of plant material.
- 2. Morphological studies of callus (sectioning and microscopic studies)
- 3. Sub culture of callus for shoot induction
- 4. Sub culture for callus for root induction
- 5. Embryo culture of Maize
- Isolation of plant protoplasts (e.g. tobacco, petunia) using enzymes available commercially and estimation of their yield.
- 7. Preparation of synthetic seeds.
- 8. Single cell isolation.

Suggested Readings

- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. Molecular Biology of Cell. Garland Publishing Co., Inc., New York, USA.
- Bhojwani, S.S. 1990. Plant Tissue Culture: Applications and Limitations. Elsevier Science Publishers, New York, USA.
- Buchanan, B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland, USA.
- Collins, H.A. and Edwards, S. 1998. Plant Cell Culture. Bios Scientific Publishers, Oxford, UK.
- Dennis, D.T., Turpin, D.H., Lefebvre, D.O. and Layzell, D.B. (eds) 1997. Plant Metabolism (~d Edition). Longman, Essex, England.
- Lea, P .J. and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology (2'd Edition). John Wiley and Sons.. Chichester, England.
- Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and' Darnell, J. 2000. Molecular Cell Biology (4' Edition). W.H. Freeman and Co., New York, USA.
- Old, R.W. and Primrose, S.B. 1989. Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford, UK. Raghavan, V. 1986. Embryogenesis in Angiosperms: A Developmental and Experimental Study. Cambridge University Press, New York, USA.
- Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, The Netherlands.

Fourth.Y. B.Sc. (Botany): SEMESTER VII

[BSEDBOT 701](#): ANATOMY AND DEVELOPMENTAL BIOLOGY OF FLOWERING PLANTS

Theory:

Phanerogams, the seed bearing plants: General characteristics and types.

Meristems and development: Shoot apical meristem, root apical meristem, lateral meristems and their functions.

Secondary body of the plant: Vascular cambium; secondary xylem, wood anatomy; secondary phloem and periderm.

Organography and anatomy: leaf morphology, histology and venation; nodal anatomy; root-stem transition; general concepts of floral anatomy.

Flower: Evolution; concept of flower as a modified determinate shoot; genetic control of floral organs; functions of flower.

Structure of anther: Microsporogenesis; formation of pollen grains (male gametophyte); pollen germination; pollen tube growth.

Structure of pistil: Ovules; megasporogenesis; female gametophyte; development of embryo sac (monosporic polygonum type; bisporic allium type; tetrasporic fritillaria type).

Mechanisms and agencies of pollination: Nectaries (floral and extra floral) - structure and function; Pollen-stigma interaction; self- incompatibility.

Fertilization: Double fertilization; endosperm - types; embryogenesis - Onagrad type, Triticum type. Apomixis and Polyembryony.

Laboratory exercises:

1. Study of meristems from permanent slides.
 - Comparative anatomical structure of wood of *Artocarpus*, *Tectona grandis*, *Terminalia renulata* from sections (T.S., T.L.S. and R. L. S) and macerations.
3. Distinct anatomical features of leaf (*Nerium*, Grass, *Nymphaea*).
4. Study of leaf appendages, venation and stomata types.
- (b) Pollen studies: Chitaley's method for analysis in *Ipomoea*, *Ocimum*, *Hibiscus*, *Acacia auriculiformis* and Grass.
4. Microsporogenesis and male gametophyte development in angiosperms through Permanent slides
7. Pollen grain germination by hanging-drop and sitting-drop techniques in *Impatiens*, *Catharanthus roseus* (= *Vinca rosea*)
8. Diversity in the structure of stigma, style, stigmatic papillae and transmitting tissue of style (any available material).
9. Comparison of mating types in species exhibiting heteromorphic self incompatibility *Hamelia patens*/*Pentas*.
10. Microdissection of embryo with suspensor at different stages of development to unravel relationship between the two.
11. Microdissection of endosperm with haustoria (cucurbit).

Suggested Readings:

1. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms, 4th revised and enlarged edition. Vikas Publishing House, Delhi.
2. Carlquist, S. 1988. Comparative Wood Anatomy: Systematic, Ecological and Evolutionary Aspects of Dicotyledonous Wood. Springer-Verlag, Berlin.
3. Cronquist, A. 1968. The evolution and classification of flowering plants. Thomas Nelson (Printers) Ltd., London & Edinburgh.
4. Cutter, E.G. 1969. Part I. Cells and Tissues. Edward Arnold, London.
5. Cutter, E.G. 1971. Plant Anatomy: Experiment and Interpretation. Part II. Organs. Edward Arnold, London.
6. Delevoryas, Th. 1965. Plant Diversification. Modern Biology Series, Holt, Rinehart & Winston, New York.
7. Esau, K. 1977. Anatomy of Seed Plants, 'i.'d edition. John Wiley and Sons, New York.
8. Fahn, A. 1974. Plant Anatomy, 'i.'d edition. Pergamon Press, Oxford.
9. Foster, A.S. and Gifford, A.E.M., Jr. 1967. Comparative Morphology of Vascular Plants. Vakils, Peffer & Simons Pvt. Ltd.
10. Johri, B.M. 1984. Embryology of Angiosperms. Springer-Verlag, Berlin.
11. Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publishing Company Inc., Menlo Park, California, USA.
12. Nair, M.N.B. 1998. Wood Anatomy and Major Uses of Wood. Faculty of Forestry, Universiti Putra Malaysia, 43400 Serdang, Selangor D. E., Malaysia.
13. Raghvan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, N.Y.

14. Raghvan, V. 2000. Developmental Biology of Flowering Plants. Springer-Verlag, NY.
15. Sporne, K.R. 1977. The Morphology of Angiosperms. B.I. Publication, Bombay.
16. Steeves, T.A. and Sussex, I.M. 1989. Patterns in Plant Development, 2'd edition. Cambridge University Press, Cambridge.

BSEDBOT 702: GENETICS, PLANT BREEDING & STATISTICAL MEHODS

Theory:

Alterations in the genetic make up -changes at genetic level: Spontaneous and induced mutations; mutagens -types and mode of action; transitions, transversions and frame-shift mutations; detection of mutations.

Alterations in genetic make up -changes in chromosome structure: Origin, types and effects of duplications, deletions, inversions and translocations; meiosis in structural heterozygotes.

Alterations in genetic make up -changes in chromosome number: Origin, types and effects of auto and allopolyploidy; origin and meiosis in nullisomics, monosomics and trisomics.

Methods of plant improvement: Pure line and mass selection; techniques in hybridization; hybridization in self and cross-pollinated crops; introduction and acclimatization; hybrid vigour.

Mutations and polyploidy as methods of plant improvement.

Statistical methods: Sampling theories, data collection, processing and presentation; descriptive statistics (mean, median, mode, standard deviation, mean square value), correlation, regression, chi square, student's t- test.

Laboratory Exercises (Genetics , Plant Breeding & Statistical Methods):

1. Preparation of chromosome maps from 3-point test cross data.
 - Correlation of floral structure with pollination system (e.g. *Salvia*, *Sesamum*, pea, rice, maize, *Ricinus*).
 - Field exploration for detection of male sterile plants and estimation of their pollen fertility in locally grown crop plants (e.g. chilli).
4. Estimation of pollen ovule ratio and its bearing on pollination system.
5. Emasculation and bagging of flowers of Brassicaceae and Malvaceae pollinating them manually and estimating fruit and seed set.
2. Analysis of data for mean, mode, median, standard deviation and standard error using suitable plant samples.
7. Determination of correlation and regression using examples
8. Student 't' test and Chi square analysis
9. Colchicine based polyploidy
10. Colchicine based mutation (shoot/root/germination/chromosomes)

Suggested Readings (For Genetics , Pl. Breeding & Statistical Methods - Papers X & XIV):

1. Atheri, Y, A.G., Girton, J. R. and McDonald. 1999. The Science of Genetics. Saunders College Publishing Co., FortWorth, USA.
2. Gardener, J., Simmons, H.J. and Snustad, D.P. 1991. Principles of Genetics (5th Edition). John Wiley & Sons, NewYork.
3. Gupta, P.K. 1994. Genetics. Rastogi Publications. Shivaji Road, Meerut.
4. Gupta, P .K. 1995. Cytogenetics. Rastogi Publications, Meerut.
5. Hartl, D.L. and Jones, E. W. 1998. Genetics: Principles and Analysis (4th Edition).
6. Jones & Bartlett Publishers, Massachusetts, USA.
7. Poehlmann, J. M. and Sleeper, D. R. 1995. Breeding Field Crops. Panima Publishing House, New Delhi.
8. Russel, P.J. 1998. Genetics (5th Edition). The Benjamin/Cummings Publishing Co., Inc., USA.
9. Simmonds, N.W. 1979. Principles of Crop Improvement. Longman, London and New York.
10. Snustad, D.P. and Simmons, M.J. 2000. Principles of Genetics (2^d Edition). John Wiley & Sons, Inc., USA.
11. Sharma, J.R. 1994. Principles and Practice of Plant Breeding. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

Semester VIII

BSEDBOT 801: MICROBIOLOGY AND PLANT PATHOLOGY

Theory:

A. Microbiology:

Discovery of microorganisms; Systematics of microorganisms in biological world; Classification of microorganisms (Bergey's manual) (and characteristic features of different groups).

Methods in microbiology: Staining, sterilization methods; culture media and pure culture methods; methods for population estimation, growth determination.

Ultrastructure of microorganisms: Viruses: properties and classification; Characteristics of host-virus interaction; Mycoplasma, Prions, Viroids; bacteriophage T4 and TMV. **Prokaryotic** microorganisms; bacteria; Actinomycetes; fine structure of prokaryotic cell; Eukaryotic microorganisms; yeasts.

Genetic recombination in Prokaryotes: Conjugation, transformation and transduction; Plasmids.

Role of microorganisms in biogeochemical cycling : Nitrogen, Phosphorus and Carbon, Biological N₂ fixation; Symbiotic and asymbiotic; Mycorrhizae and their role in agriculture and forestry

Industrial application of microorganisms: Secondary metabolites; Organic acids, bread, wine, alcohol, food processing, milk products, antibiotics, biofertilizers; Mushroom cultivation.

B. Plant Pathology:

General account of Plant Pathogens: General account of diseases caused by plant pathogens; Symptomatology.

Pathogen attack and defense mechanisms: Stages of disease establishment; Physical, physiological, biochemical and molecular aspects.

Plant disease epidemiology: Transmission and spread of plant pathogens; disease cycles, epidemics; modeling and disease forecasting.

Plant disease management: Cultural, Chemical, biological; IPM systems; development of transgenics; biopesticides; Plant disease clinics.

Genetics of resistance and susceptibility: Genes for virulence and avirulence, their application in resistance and susceptibility; induced resistance (immunization).

Molecular Plant Pathology: Molecular diagnosis; identification of genes and specific molecules in disease development; molecular manipulation of disease resistance.

Application of Information Technology in Pl. Pathology: Simulation of epidemics; programmes for diagnosis; remote sensing and image analysis for ecosystem level effects; prediction of disease control decisions.

Laboratory Exercises:

(Number of lab hours should be uniformly distributed)

A. Microbiology:

1. Determination of dimensions of microorganisms (suggested model organisms: yeast, lactobacilli, Cyanobacteria).
2. Sterilization; preparation of agar medium for Bacteria and PDA solid medium and Czapeck Dox liquid medium for fungi.
3. Isolation of microorganisms: streaking on agar plates/pour plate method
4. Turbidimetric determination of growth of a microorganism using spectrophotometer (model organism: *E. coli* / yeast).
5. Determination of microbial population size (model organism: yeast; use of haemocytometer, serial dilution technique, relationship between dilution and cell count, determination of standard error, reliability in cell counts).
6. Mycorrhizal preparation using trypan blue / cotton blue. Demonstration ecto- and endomycorrhizae; wet-sieving and decanting method for isolation of arbuscular mycorrhizae.
7. Isolation and inoculation of bacterial and fungal pathogens.
8. Anatomical observations of fungal infected plants (rust, blight, rots).

B. Plant Pathology:

1. Study of symptomatology, morphology and anatomy of important locally available plant diseases symptoms and host-parasite relationship (One viral, bacterial and fungal).
2. Isolation and culture of plant pathogens (e.g. *Colletotrichum*/*Fusarium*/*Alternaria*) and establishment of Koch's postulates and their pathogenicity.

Suggested reading materials:

1. Agrios, G.N. 1997. Plant Pathology. Academic Press, London.
2. Albajes, R., Gullino, M.L., van Lenteren, J.C. and Elad, Y. 2000. Integrated Pest and Disease Management in Greenhouse Crops. Kluwer Academic Publishers.
3. Bridge, P. et al. 1998. Molecular Variability of Fungal Pathogens. CAB International, UK.
4. Bridge, P. et al. 1999. Application of PCR in Mycology. CAB International, UK.
5. Bridge, P., Moore, D.R. and Scott, P.R. 1998. Information Technology, Plant Pathology and Biodiversity. CAB International, UK.
6. Persley, G.J. 1996. Biotechnologies and Integrated Pest Management. CAB International, UK.
7. Skerritt, J.H. and Apples, R. 1995. New Diagnostics in Crop Sciences. CAB International, UK.
8. Sullia, S.B. 2001. General Microbiology, Oxford Publishers, New Delhi
9. Tauro, P.T. 1988. Introductory Microbiology.
10. Vaidya, J.C. 2000. Biology of Fungi.
11. And any other latest books on the subject

Suggested Readings (for laboratory exercises):

1. Eklund, C. and Lankford, C.WE. 1967. Laboratory Manual for General Microbiology. Prentice-Hall, Inc., Engle-wood Cliffs, N.J.
2. Gunasekaran, P. 1995. Laboratory Manual in Microbiology. New Age International Pvt Ltd.
3. Pawsey, R.K. 1974. Techniques with Bacteria- A Guidebook for Teachers. Hutchinson Educational.
4. Pelezor, M.J. and Chan, E.C.S. 1972. Laboratory Exercises in Microbiology. McGraw Hill Book Co.
5. Meyneil, E. and Meynell, G.G. 1970. Theory and Practice in Experimental Bacteriology.. University Press, Cambridge.
6. Wistreich, G.A. and Lechtman, M.D. 1973. Laboratory Exercises in Microbiology. Glencoe Press, New York, Beverly Hills, Collier Macmillan Publishers, London.
7. Aneja, K. R. 1993. Experiments in Microbiology, Plant Pathology and Tissue Culture. Wishwa Publication, New Delhi.
8. Mahadevan, A. and Sridhar, R. 1986. Methods in Physiological Plant Pathology. Sivakami Publication, Madras.
9. Schaad, N. W. 1988. Plant Pathogenic Bacteria: Laboratory Guide for Identification of Plant Pathogenic Bacteria. Academic Press.

Journals/Series

1. Methods in Microbiology ; Methods in Enzymology ; Methods in Biochemistry
2. Indian Journal of Mycology & Plant Pathology, Jodhpur
3. Mycorrhiza News Letter, TERI, New Delhi
4. Indian Journal of Microbiology.

BSEDBOT 802: ECONOMIC AND APPLIED BOTANY**Theory:**

Ethnobotany: Introduction to indigenous knowledge and ethnobotany; ethnobotanical knowledge

in bioprospecting.

Agroclimatic regions and major crops of India: Major features and crops. Botanical names, part used, climatic requirements and popular cultivars if any of the following: Cereals and illets: wheat, rice, maize, sorghum, bajra, finger millet. Pulses: Chickpea (Bengal gram), red gram (arhar), black gram, green gram Vegetable oil sources: Mustard, groundnut, sunflower, sesame and coconut Tuber crops: Yams, Tapioca, Potato, Sweet potato Fruits: Mango, Banana, Jack fruit, Papaya, Pine apple, Apple, Oranges. grapes. Vegetable: Brinjal, Okhra, Ridge gourd, tomato, onion, Amaranth, radish Spices and condiments: Capsicum, Cinnamon, Black pepper, turmeric, ginger Cash crops: Tea, coffee, rubber, cashew, cocoa, sugarcane Plant fibres: Cotton, jute, sisal and coir. Timber plants of Goa: *Matti*, *Kindal*, *Sailo*, *Ponas*, *sisam*, bamboo. Miscellaneous: Dye-*Bixa*; essential oil - *Eucalyptus*; insecticidal - neem; fodder –subabul.

Medicinal plants: A brief account of plant drugs and their chief constituents used in indigenous and allopathic systems of medicine with regard to *Rauwolfia serpentina*, *Hemidesmus indicus*, *Garcinia indica*, *Holorrhena antidysentrica*, *Andrographis paniculata*, *Catharanthus roseus*, *Aloe vera*, *Tinospora cordifolia*, *Adhatoda vasica*, *Boerhaavia diffusa*.

Floriculture: Scope and present status in India; basic aspects of cultivation of Orchids, Anthuriums, Gerbera, Crossandra, Carnation, Jasminum.

Horticulture: Concept & application, Landscape gardening, Kitchen gardening, Rock gardening, Lawn making, Bonsai, Horticultural crops of Goa.

Vegetative Propagation

Concepts & Applications of Sericulture & Apiculture.

Forestry: Silviculture, Agroforestry & Social Forestry.

Laboratory Exercises:

1. Identification (botanical name and family), description and utilization of plants and/or plant parts studied in theory, under each group, including floriculture plants.
- Chemical tests for oil: Sesame/**groundnut** T.S. of *Eucalyptus* leaf to study oil glands.
3. Properties of plant fibres: Cotton, Jute and coir.
4. Study of plants (live or from herbarium specimens) used as sources of drugs: (*Rauwolfia serpentina*, *Adhatoda vasica*, *Tinospora cordifolia*, *Terminalia bellirica*, *Holorrhena antidysentrica*, *Garcinia indica*, *Andrographis paniculata*, *Catharanthus rosesus*, *Hemidesmus indicus*, *Boerrhavia diffusa* and *Aloe vera*.
2. Extraction of plant pigments in water, ethanol and n-hexane of any two: e.g. *Curcuma longa* (turmeric), *Bixa orellana* (annato), *Lawsonia inermis* (mehndi), *Garcinia indica* (Kokum).
6. Vegetative propagation techniques
- 6) Preparation of a list of trees and shrubs used as ornamentals along with their popular and scientific names. Seasons of flowering and brief description. Calendar of seasonals grown as bed plants, potted plants, houseplants, and flowers used for worship or ornamentation. This may be illustrated and presented as a term paper at the time of examination.

Suggested Readings:

1. Carlquist, S. 1988. Comparative Wood Anatomy: Systematic, Ecological and Evolutionary Aspects of Dicotyledonous Wood. Springer-Verlag, Berlin.
2. Fuller, K.W. and Gallon, J.A. 1985. Plant Products and New Technology. Clarendon Press, Oxford, New York.
3. Hill Economic Botany
4. Kocchar, S.L. 1998. Economic Botany in Tropics, 'i.'d edition. Macmillan India Ltd., New Delhi.
5. Nair, M.N.B. 1998. Wood Anatomy and Major Uses of Wood. Faculty of Forestry, Universiti Putra Malaysia, 43400 Serdang, Selangor D. E., Malaysia.
6. Sambamurthy, A.V.S.S. and Subramanyam, N.S. 1989. A Textbook of Economic Botany. Wiley Eastern Ltd., New Delhi.
7. Sharma, O.P. 1996. Hill's Economic Botany. Tata McGraw Hill Publishing Company Ltd., New Delhi.
8. Simpson, B.B. and Conner-Ogorzaly, M. 1986. Economic Botany- Plants in Our World. McGraw Hill, New York.
9. Thomas, P. 2000. Trees: Their Natural History. Cambridge University Press, Cambridge.
10. Tippo, O. and Stern, W.L. 1977. Humanistic Botany. W.W. Norton, New York.
11. Vishnu Swarup 1997. Ornamental Horticulture. Macmillan India Ltd., New Delhi.

FIELD WORK

In addition to the requisite number of lectures and practicals, a student of Botany at F.Y./ S. Y./ T. Y. B. Sc. course is required to undertake field work / study tour to acquaint with the practical aspects of the subject as well as learn the recent developments in the subject by visiting research institutes / Universities under the guidance of a teacher as per the details shown below:

Course	Field trips / study tours
F.Y. B. Sc. (Semester I & II together)	Two local field trips (one in each semester)
S.Y. B. Sc. (Semester III & IV together)	Two local field trips in semester III Short tour of not less than four days outside Goa in semester IV .
T.Y. B.Sc. (Semester V & VI)	Three local field trips in semester V and one long study tour outside the state of Goa of not less than 10 days in semester VI .

Note 1: Total duration of each local field trip should not be less than eight hours.

1. The teacher student ratio for the purpose of field trip / study tour be same as that for practicals.
3. The students are required to maintain a field record to be submitted at the time of practical examination.
4. Field trips / study tours should be to the places other than the ones mentioned in the practicals.
5. As per the circular No. GU/V/Gen. Appt./30/97/3754 dated 26.6.1997 following will be the work load for field work/study tour in Botany.

F.Y. B.Sc. - One period/week/batch
S. Y. B.Sc. - Two periods/week/batch
T.Y. B.Sc. - Five periods/week/batch

The syllabus to be implemented in phased manner from 2011-12

Approved by B.O.S. in Botany dated 19th April 2011

Chairman, BOS in Botany
Goa University

Syllabus of B.Sc.B.Ed (Zoology)

Implemented from:

FYBSc: 2010-11 (Approved in BOS March 2010, AC in April 2010)

SYBSc: 2011-12 (Approved in BOS February 2011, AC in March 2011)

TYBSc: 2009-10

A brief description of the course:

Purpose :

- 31) To understand the diversity of fauna (non chordate and chordate), structure and function of the different form of life and their relationship, the relationship between life and environment.
- 32) To understand the structure and function of cell, basics of molecular biology, basic of animal biotechnology.
- 33) To understand the scope of entrepreneurship through Applied Zoology.

Prerequisites : Elementary knowledge of Biology at Higher secondary level (10+2 level) with back ground knowledge of Chemistry.

Number of Semester: Six.

In the first four semesters: in each semester, a student has to study 2 papers of 100 marks (75 marks for theory and 25 marks for practical)

In the fifth and sixth semester: In each semester a student has to study 4 theory papers and 2 practical papers, each of 100 marks.

Project work (in group) of 100 marks

Field work: A compulsory component of practical knowledge for all semesters.

Institutions: Dhempe College, PES College, Carmel College, Quepem Govt. College, Chowgule College & Sanquelim Govt. College

F.Y.B.Sc.

I SEMESTER	
PAPER CODE	PAPER TITLE
BSEDZOO 101	Diversity of Lower Non Chordates: Practicals:
BSEDZOO 102	Cell Biology: Practicals:
	II SEMESTER
BSEDZOO 201	Diversity of Higher Non-Chordate: Practicals:
BSEDZOO 202	Genetics & Molecular Biology: Practicals

S.Y. B.Sc.

III SEMESTER	
BSEDZ OO 301	Diversity of Lower Chordates: Practicals:
BSEDZ OO 302	Animal Physiology: Practicals:
IV SEMESTER	
BSEDZ OO 401	Diversity of Higher Chordates: Practicals:

BSEDZ OO 402	Ecology & Animal Behaviour: Practicals:
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T.Y. B.Sc (Special)

V SEMESTER	
BSEDZOO 501	Comparative Anatomy of Vertebrates
BSEDZOO 502	Human Physiology & Biochemistry
BSEDZOO 503	Practicals: a. Comparative Anatomy of Vertebrates b. Human Physiology & Biochemistry
VI SEMESTER	
BSEDZOO 601	Applied Genetics & Evolution
BSEDZOO 602	Basic Animal Biotechnology
BSEDZOO 603	Practicals: a. Applied Genetics & Evolution b. Basic Animal Biotechnology
Fourth Y. B.Sc (Special) VII SEMESTER	
BSEDZOO 701	Developmental Biology
BSEDZOO 702	Endocrinology
BSEDZOO 703	Practicals: a. Developmental Biology b. Endocrinology
VIII SEMESTER	
BSEDZOO 801	Environmental Biology & Toxicology

BSEDZOO 802	Animal Biotechnology Applications
BSEDZOO 803	Practicals: a. Environmental Biology & Toxicology b. Animal Biotechnology Applications

(GENERAL)

V

Semester

BSEDZOO G 01	Comparative Anatomy of Vertebrates & Histology
BSEDZOO G 02	Environmental Physiology
BSEDZOO G 03	Practicals: a. Comparative Anatomy of Vertebrates & Histology b. Environmental Physiology

VI Term

BSEDZOO G 04	Applied Genetics
BSEDZOO G 05	Economic Zoology
BSEDZOO G 05	Practicals: a. Applied Genetics b. Economic Zoology

CODE	CLASS	SEMESTER	TITLE
BSEDZOO 101	F.Y.B. Sc.	I	Diversity of Lower Non- Chordates

Objectives & Scope:

14. Review of the general characters and classification of the phyla listed below (up to classes).
Classification of animals to be followed as in **“Invertebrate Zoology” by E L Jordan & PS Verma.**
15. The gross anatomy and life history of the types mentioned.
16. Local examples with common and scientific names are to be given more emphasis for all the groups.
17. Those not found in India too has to be cited as example because of taxonomic / phylogenetic or of other special significance.
18. At least one example from each class of invertebrates has to be included. Only those examples need to be mentioned which explain the general characters of the phylum / class.

I .General principles of animal taxonomy.

Binomial nomenclature; hierarchy

Salient features of non-chordates and classification up to classes

Definition of species.

Phylogeny of non- Chordata

II. Phylum Protozoa

General Topic ----- Comparative account of locomotion with respect to-Sarcodina, Mastigophora, Ciliophora; Nutrition and Skeleton in Protozoa.

III. Phylum Porifera

Type -----*Sycon*

General Topic ----- Cell types, Skeleton, Canal system and Reproduction

IV. Phylum Cnidaria

Type -----*Obelia*

General Topic ----- Gastrovascular cavity, Polymorphism
Coral reefs (Definition, types and economic importance).

V. Phylum Platyhelminthes

Type ----- *Planaria*.

General Topic----- Parasitism & Parasitic adaptation in Platyhelminthes

VI. Phylum Aschelminthes

General Topic ----- Bionomic importance of Nematodes.

VII. Phylum Annelida

Type ----- *Nereis*

General Topic----- Metamerism in Annelids.

Text / Reference Books recommended:

12. Barnes, R. D. (2000). Invertebrate Zoology. Hall Saunders International Editions
13. Kotpal, R. L (2000). Invertebrates. Rastogi Publication, Meerut.
14. Ganguli, B.B.; Sinha, A.K., and Adhikari, S. (2000). Biology of Animals Vol-1. New Central Book Agency, Calcutta.
15. Ayer Ekabaranath, M. (2000). A Manual of Zoology. Vol. I Part I & II. S. Viswanath, Madras.
16. Dhami, P. S. and Dhami, J. K. (2000). Invertebrate Zoology, S. Chand & Co. Pvt. Ltd. New Delhi.
17. Jorden, E. L. & Verma, P.S. (2000). Invertebrate Zoology. S. Chand & Co. Pvt. Ltd. New

- Delhi.
18. Parker, A.J. & Haswell, W.A.A. (2002). Textbook of Zoology. Vol. I. Macmillan.
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PRACTICALS

- 15) Study of animals with special reference to systematic position up to order level Habit, Habitat, Characteristic Features and Economic Importance of-----
Protozoa, Porifera, Cnidaria, Platyhelminthes, Aschelminthes, Annelida with at least One example from each class.

Observation of the following permanent slides:

T.S. of Sponges, *Obelia*, *Ascaris* (male & female), *Nereis*, *Planaria* & Liverfluke, Tapeworm scolex, Larval forms of Liverfluke.

- 13) Mountings:

Spicules in sponges, Parapodia of *Nereis*, Nematocyst of sea anemone, Setae and Nephridium from earthworm

- 14) Dissection:

Earthworm – Digestive system and Nervous system.

5. Identification of protozoans in pond water sample.

CODE	CLASS	SEMESTER	TITLE
BSEDZ OO 102	F.Y.B. Sc.	I	Cell Biology

Objectives & Scope:

- To make the students understand the structure and functions of cell organelles
- To understand the importance of nucleus in the cell
- To understand the role of various physical and chemical components of the cell
- To have basic knowledge of cancer biology
- To learn basic techniques in cytology

I. Overview of the General structure and organization of cells.

Viruses, Prokaryotic and Eukaryotic Cells.

II. Cell Environment.

Water, Salts and Ions; Biological molecules; Freezing and Thawing of cells;

Radiations in Cell environment (UV radiations, photodynamic sensitization).

(Treat as in Cell Physiology By Arthur C. Giese, 1983)

III. Cell Organelles

- Plasma Membrane:
Isolation and Characterization with reference to Composition, Fluid- Mosaic Model; Passive transport, Active transport and Bulk Transport.
Mitochondria:
Isolation, Chemical Composition, Ultra structure and functions with reference to energy transactions – Kreb's Cycle, Electron Transport system; Mitochondria as a semiautonomous organelle.
- 8) Isolation, Chemical composition, structure and functions of :
 - Endoplasmic reticulum
 - Ribosomes
 - Golgi complex
 - Lysosomes and polymorphism
 - Microbodies
 - Cytoskeleton – Microtubules, Microfilaments and Centrioles.**(Treat as in Cell Biology by C. B. Powar 2004)**

IV. Cell Nucleus 6 ch Isolation, Nucleus envelope, Nucleoplasm; General structure of metaphasic eukarytic

Chromosome; Euchromatin, Heterochromatin, Nucleolus, Structure of Nucleosome; Polytene and Lamp Brush Chromosome.

V. Cancer Biology

General idea of cancer cells, Carcinomas, Sarcomas, Lymphomas, Leukemia; Characteristics of Cancer cells; Carcinogenesis - Mutation and Viral theories of Carcinogenesis; Environmental causes of cancer; Prevention and treatment

VI. Techniques in Cell Biology

- Principles and application of :
- Electron microscopy
 - Centrifugation (ultra and refrigerated) techniques,
 - TLC and Gel electrophoresis

Text / Reference Books recommended:

- 20) Giese, A. (1983). Cell Physiology Saunders International edition
 - 21) Powar, C.B. (2004). Cell biology, Himalaya Publication
 - 22) DeRobertis & Deli Robertis (2000). Cell and Molecular Biology. 6th Edition
 - 23) Bhamrah, H.S.; Kavita Juneja. Molecular Cell Biology. Anmol Publications Pvt. Ltd, New Delhi
 - 24) Kumar, H.D. (1996). Molecular Biology and Biotechnology, Vikas Publication, New Delhi.
 - 25) Verma and Agarwal (2004). Cell Biology, Genetics, Molecular Biology, Evolution & Ecology. S. Chand & Co. Ltd. New Delhi.
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PRACTICALS

18. Study of Prokaryotic cells using suitable staining techniques. Bacteria (Gram +ve and gram –ve) from curd and tarter

Study of Eukaryotic Cell using suitable staining technique (Buccal epithelial Cells)

3. Methods of Protozoan culture (any two types)
4. Study of cytoplasmic movements (Cyclosis) in *Paramecium*.
5. Cytoplasmic localization of Protein , Fat and Carbohydrates
6. Study of osmosis using human R.B.Cs.
7. Buccal smear preparation for localization of Mitochondria by using Janus Green stain
8. Study of Polytene chromosomes in *Drosophila* or *Chironomus* larva.
9. Study of Cancer cells through permanent slides.
10. Study of Cell organelle (any 3) through electron micrographs.
11. Separation of serum proteins by Electrophoresis (only for demonstration).
- 12 Separation of fats by TLC

CODE	CLASS	SEMESTER	TITLE
BSEDZO O 201	F.Y.B. Sc.	II	Diversity of Higher Non- Chordates

Objectives & Scopes:

7. Review of the general characters and classification of the phyla listed below (up to classes). Classification of animals to be followed as in “**Invertebrate Zoology**” by **E L Jordan & PS Verma**.
8. The gross anatomy and life history of the types mentioned.
9. Local examples with common and scientific names are to be given more emphasis for all the groups.
10. Those not found in India too has to be cited as example because of taxonomic / phylogenetic or of other special significance.
11. At least one example from each class of invertebrates has to be included. Only those examples need to be mentioned which explain the general characters of the phylum / class.

I. Phylum Onychophora

General topic-----Affinities and systematic position.

II. Phylum Arthropoda

Type – Prawn (*Penaeus* sp)

General Topics – Crustaceans Larvae,

III. Phylum Arthropoda (General topics)

Respiration and excretion in Arthropoda; Metamorphosis in Insects,
Mouth parts of insects.

IV. Phylum Mollusca.

Type----- *Pila*

General Topics – Foot and shell in Mollusca; Torsion in Gastropoda,.

V. Phylum Echinodermata

Type ----- Starfish

General Topics ----- Larvae of echinoderms and symmetry in Echinodermata.

V I. Phylum Hemichordata

General type-----Affinities and systematic position.

Text / Reference Books recommended:

1. Barnes, R. D. (2000). Invertebrate Zoology. Hall Saunders International Editions
 - 7 Kotpal, R. L. (2000). Invertebrates. Rastogi Publication, Meerut.
 - 8 Ganguli, B. B., Sinha, A. K. and Adhikari, S. (2000). Biology of Animals Vol-1. New Central Book Agency, Calcutta.
 - 9 Ayer Ekabaranath, M. (2000). A Manual of Zoology. Vol. I Part I & II. S. Viswanath, Madras.
 - 10 Dhami, P.S. and Dhami, J. K. (2000). Invertebrate Zoology, S. Chand & Co. Pvt. Ltd. New Delhi.
 - 11 Jordan, E. L. and Verma, P.S. (2000). Invertebrate Zoology. S. Chand & Co. Pvt. Ltd. New Delhi.
 - 12 Parker, A.J. and Haswell, W.A.A. (2002). Textbook of Zoology. Vol. I. Macmillan.
-

PRACTICALS:

4. Studies of animals with special reference to systematic position up to order level-

Habit, Habitat, Characteristic features, and Economic importance of – Onychophora, Arthropoda, Mollusca, Echinodermata, Hemichordata, with at least one example from each class.

5. Observation of the following permanent slides. Larval forms of Crustacea (any 5 only), larval forms

of Echinoderms (any 3 only).

6. Mountings:

- a) Honeybee- Mouth parts, legs and sting apparatus
- b) Housefly- Mouth parts
- c) Cockroach – Mouth parts,
- d) Appendages of Prawn

7. Dissection

- a. Prawn – Nervous system.
- b. Pila – Digestive system

8. Listing and identifying local butterflies and preparation of checklist of butterflies of college campus.

CODE	CLASS	SEMESTER	TITLE
BSEDZ OO 202	F.Y.B. Sc.	II	Genetics and Molecular Biology

Objectives & Scope:

- 2. To understand the importance of Genetics
- 3. To have basic knowledge breeding and mutation
- 4. To understand the basics of Molecular biology
- 5. To learn basics in genetic engineering and animal biotechnology

I. Overview of Mendelian genetics and Modifications.

9:7, 13:3, 15:1), Epistasis and Hypostasis.
Multiple alleles – Eg. Coat colour in Rabbit.
Multiple genes - Eg. Skin colour in Man.

II. Sex Determination and Sex related Inheritance.

Sex Determination in Drosophila,

III. Human Genetics.

IV. Gene Mutations

induced mutation (chemical mutagens and radiation)

V. Inbreeding and Heterosis

Introduction to restriction enzymes; Ligases; Cloning vectors (Plasmids, Cosmids, Phagemids)
Application of Animal Biotechnology with reference to Aquaculture, Livestock (cattle), and Human health (Hormone and vaccines).

Text / Reference Books recommended:

- o) Powar, C.B. (2003) “Genetics” Vol.I & Vol II.**
 - p) Verma P.S. and V. K. Agarwal (2008) Cell biology, Genetics, molecular Biology, Evolutionary Ecology, S. Chand & Co. New Delhi**
 - q) Singh, B. D. (2002) Biotechnology,**
 - xv) Bhamrah, H. S. and Kavita Juneja. “Molecular cell Biology”, Anmol publications Pvt. Ltd.
 - xvi) Gupta, P.K. (1996) “Genetics” Rastogi Publications.
 - xvii) Ranga, M.M. “Animal Biotechnology (Agrobios), Published by Agrobios (India).
 - xviii) Rastogi, Sharma, V.N. and Anuradha Tandon (1993). “Concepts in Molecular Biology”. Wiley Eastern Ltd. N. Delhi.
 - xix) Smustad, Simmons, Jenkins (1999). “Principles of Genetics” John Wiley and sons. Inc.
 - xx) Daniel Fairbanks, W. Ralph Anderson. “Genetics, the Continuity of Life” (1999). Brooks/Cole Publishing Company, New York.
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PRACTICALS

Problems in Genetics through beads / seeds mixtures. Monohybrid and Dihybrid ratios.

Problems in Genetics on multiple alleles and Quantitative inheritance (multiple genes).

Preparation of Diploid complement of Rat or Mice by air drying technique.

- 6. Study of ABO blood group and Rh factor in Humans.
- 7. Drosophila culture techniques.
- 6. Study of phenotypic characters in Drosophila (Body colour, Wing pattern and Eye colour).
- 7) Determination of sex by Barr body method.
- 8) Karyotyping Analysis in Humans from Printed material.
 - a. Normal male or female
 - i) Klinefelter’s Syndrome
 - ii) Turner’s Syndrome
 - iii) Down’s Syndrome
 - iv) Philadelphia
- 14. Determination of allelic frequency of the following Mendelian Human traits-

Tongue Rolling, Ear lobes, Widow’s peak, Clasping of hand, Thumb crossing pattern, Folding of arms, Hitch-hiker’s thumb..

General note on field work:

In addition to the practical component, the student should undertake at least two Field Trips of not less than eight hours duration each (The fieldwork is to be treated as two contact hours per batch per week).

S.Y.B.Sc.

CODE	CLASS	SEMESTER	TITLE
301	S.Y.B. Sc.	III	Diversity of Lower Chordates

I: Biodiversity

Definition, levels of biodiversity – genetic, species and ecosystem level diversity.

Conservation strategies; Biodiversity hotspots of India with examples and salient features.

II : Chordata

General characters, outline classification up to class, origin of chordates.

III : Protochordates

Urochordata: General characters, Classification up to order, Phylogenetic relationships

Cephalochordata: External features of Branchiostoma; Affinities and Systematic position.

IV: Vertebrata

General characters

Agnatha: Ostracodermi : Important features

Cyclostomata : General characters, Affinities and phylogenetic status

Gnathostomata : Important features.

V : Superclass pisces

Classification up to order level.

Chondrichthyes : General characters and distribution with examples.

Osteichthyes : General characters and distribution with examples.

Dipnoi – General characters, affinities and systematic position.

VI. Pisces (General features)

Air bladder in fishes, Accessory respiratory organs, Scales in fish, Migration in fishes, Parental care in fishes, Origin and types of fins, Adaptive radiation in teleostei, Economic importance of fishes.

Text / Reference Books recommended:

- 1) Ayer, Ekambaranath H and Anantha Krishnan, T. N. Manual of Zoology Vol. II (Chordata) S. Viswanathan (Printers and publishers) Pvt. Ltd., Madras.
 - 2) Sinha, A.K., Adhikari, S., Ganguly, B.B., Biology of Animals. Vol. II New Central Book Agency, Calcutta.
 - 3) Jordan, E. L., & Verma, P.S., Chordate Zoology (New Edn.) S. Chand & Co.
 - 4) Dhami & Dhami – Chordate Zoology.
 - 5) Kotpal, R.L., Modern Text book of Zoology Vertebrates Rastogi Publications, Shivaji Road, Meerut.
 - 6) Dr. Nigam, H.C., Biology of Chordates, Vishal Publications, Adda Hoshiarpur, Jalandhar city.
 - 7) Prasad, S. N., Chordates, Vikas Publishing House, Pvt. Ltd.
 - 8) Parker, A.J. & Haswell, W.A., A Textbook of Zoology, Vol. II (New Ed.) Low price – publications, Delhi – 110052.
 - 9) Agarwal & Dalela – A textbook of vertebrate Zoology.
-

PRACTICALS:

A. Museum specimens and slides :

Commonly available museum specimens with reference to protochordates, cyclostomata and pisces.

4) Observations : Accessory respiratory organs of two types.

5) Mountings :

The study of types of scales and weberian ossicles. Study of Ampulla of Lorenzini and internal ear of a bony fish.

D. Dissections

Brain of bony fish, Digestive system in bonyfish, heart and aortic arches in bonyfish.

E. Study of local edible fishes :

Study of type of fins in fishes.

Study of economically important fishes.

CODE	CLASS	SEMESTER	TITLE
	S.Y.B. Sc.	III	Animal Physiology

BSEDZ OO 302			
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I Digestion 7ch Outline of digestive system and associated glands in mammals, including peristalsis. Salivary digestion, Gastro –Intestinal digestion; Role gastro-intestinal hormone,

Role of Pancreas, Liver; Symbiotic digestion (pre and post gastric);

Absorption, assimilation, defecation; Concept of balanced diet in humans.

II Respiration 8 ch Ventilation, Mechanism of breathing; Cellular respiration: Glycolysis, citric acid cycle, Electron transport chain (Glycolysis to be dealt in details); Gaseous exchange: oxygen Absorption, transport and delivery to the tissues; Carbon dioxide transport- chloride shift and Bohr effect.

Respiratory pigments: haemoglobin, hemocyanin, chlorocruonin. Regulation of

Respiration: nervous and chemical.

III Circulation

Types of hearts (Neurogenic and myogenic)

Conduction and regulation of heart beat in myogenic heart.

Cardiac cycle and ECG (human).

Haemodynamics- Regulation of blood pressure, blood viscosity, friction,
capillary pressure.

Tachycardia, bradycardia.

IV Contraction and Movement

Types of muscles: structural and functional;

Structure and properties of smooth and cardiac muscles.

Skeletal Muscle: Ultrastructure, chemical composition and functional properties (muscle twitch, summation, tetany, fatigue). Sliding filament theory of muscle contraction and its physiological basis; Role of neurotransmitters (acetylcholine and adrenaline) in muscle contraction.

V Excretion and Osmoregulation

Types of Nitrogenous waste: ammonia, urea and uric acid; Urea Cycle.

Mammalian kidney: Functions of Kidney; Structure of mammalian nephron and process of urine formation.

Role of kidney in osmoregulation and acid base balance; Hormonal control of kidney.

VI Reproduction

Structural and functional aspects of testis, Onset of puberty (development of secondary sexual character). Menstrual cycle in relation to ovarian cycle and menopause. Estrous cycle; Methods of fertility control : physical chemical and surgical.

Text / Reference Books recommended :

- 1 Mohan P. Arora 'Animal physiology' Himalaya publishing house.
- 1) Eckert R. "Animal physiology" CBS publishers.
- 1 R. Nagabhushanam, M. S. Kadarkar, R. Sarojini 'Text book of animal physiology', second edition, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi, Kolkata.
- 4 Vander, Sherman Luciano "Human physiology" MacGraw Hill publication.
1. Hoar "General and Comparative physiology" Prentice Hall.
- 6 Sujit Choudhuri "Concise medical physiology" New Central Book Agency.
- 7 Verma, Tyagi and Agarwal 'Animal physiology' S. Chand and Company.

PRACTICALS:

3. Preparation of haemin crystals and haemoglobin estimation of man (Sahlis method).

Detect the presence of Albumin, sugar, uric acid, ketone/ acetone bodies, chlorides, phosphates, calcium, bilirubin from urine sample.
10. Survey of digestive enzymes in the gut of cockroach.
11. Study of oxygen consumption in cockroach with reference to body weight.
12. Transport of glucose (qualitative) across the intestine of rat/ chick.
6. Determination of pulse rate at rest/ after exercise and measurement of blood pressure using sphygmomanometer and stethoscope in man.

7. A visit to the hospitals / primary health center to know about human fertility control methods and devices. Submission of report.

11. Composition and preparation of physiological solutions, buffers, vital stains, fixatives, stains.

CODE	CLASS	SEMESTER	TITLE
BSEDZ OO 401	S.Y.B. Sc.	IV	Diversity of Higher Chordates

17. Depletion of biodiversity due to anthropogenic activities Benefits from Biodiversity, Introduction to Biodiversity Act, 2002, major threat to chordate biodiversity.

II. Amphibia

General characters and classification of amphibian diversity up to orders. Distinguishing features of anurans, apoda and urodela with suitable examples.

Origin of Amphibia, Parental care in Amphibia, Neotony and Paedogenesis.

III. Reptilia

General characters and classification of reptiles up to orders (living orders only) with suitable examples.

Reptilian diversity with reference to diverse habitats.

Indian snakes (venomous and non venomous), Temporal fossae and arcades in reptiles, Poison apparatus and its working mechanisms, Extinct reptiles, Sense organs in reptiles.

IV. Aves

General characters and classification up to order level giving suitable examples.

Birds as glorified reptiles, Flight adaptations in birds, Flightless birds or Ratitae, Diversity and adaptations of woodland, grassland, wetland and shore birds, Migration of birds.

V. Mammalia

General characters and classification up to orders Distinctive features of prototheria, metatheria and eutheria with important examples, Affinities of prototheria,.

VI. Mammalia (General features)

Flying mammals, Dentition in mammals, Aquatic mammals.

Detailed study general viscera and digestive systems of rat.

Text / Reference Books recommended:

- Ayer, Ekambaranath H and Anantha Krishnan, T. N. Manual of Zoology Vol. II (Chordata) S. Viswanathan (Printers and publishers) Pvt. Ltd., Madras.
- Sinha, A.K., Adhikari, S., Ganguly, B.B., Biology of Animals. Vol. II New Central Book Agency, Calcutta.
- Jordan, E. L., & Verma, P.S., Chordate Zoology (New Edn.) S. Chand & Co.
- Dhami & Dhami – Chordate Zoology.
- Kotpal, R.L., Modern Text book of Zoology Vertebrates Rastogi Publications, Shivaji Road, Meerut.
- Nigam, H.C., Biology of Chordates, Vishal Publications, Adda Hoshiarpur, Jolandhar city.
- Prasad, S. N., Chordates, Vikas Publishing House, Pvt. Ltd.
- Parker, A.J. & Haswell, W.A., A Textbook of Zoology, Vol. II (New Ed.) Low price – publications, Delhi – 110052.
- Agarwal & Dalela – A textbook of vertebrate Zoology.
- Salim Ali & Dillon Ripley, S., - A pictorial guide to the Birds of the Indian Subcontinent, Bombay Natural History Society, Oxford University Press, 1995.

PRACTICALS:

A. Museum specimens and slides :

Commonly available specimens to be shown with at least one example for each living orders in class amphibia, reptilia, aves and mammalia, the study may be made complete through field study as well.

B. Observation :

- Of four different types of beaks and feet in the birds surrounding your area / campus,
- Identification of venomous and non venomous snakes.

6. Mountings

Mounting of pecten in any suitable specimen,
Types of feathers in birds.

7. Dissections

Brain of rat, general viscera in rat,

E. Field Oriented study

Bird watching and preparation of checklist of birds of college campus.

CODE	CLASS	SEMESTER	TITLE
BSEDZ OO 402	S.Y.B. Sc.	IV	Ecology & Animal Behaviour

I: Environmental factors and animal interactions

- Introduction, Shelford's law of tolerance; liebig's law of minimum;
- Physical factors: soil-classification of soil, soil profile and soil biota; Temperature-
Effect of temperature on animals, Thermal stratification in lakes and sea; Light-
Effect of light on animals, light stratification in lakes and sea; Water-water as a
medium for life,
- Chemical factors: Atmospheric gases, dissolved gases, pH, nutrients, and food.
- Inter specific interactions-mutualism, commensalisms, amensalism
(antibiosis), parasitism, and predation.

II: Community

Introduction, characters of a community, classification of a community, community periodism, community stratification, community succession, development of animal community in hydrosere and xerosere; climax community, ecotone and edge effect.

III: Ecological adaptations of animals

Kinds of adaptations (inherited and acquired adaptations)

10. Structural adaptations (Aquatic, pelagic, deep sea, desert, volant, cursorial, fossorial and subterranean adaptations, parasitic adaptations)
11. Physiological adaptations
12. Protective adaptations
13. Mimicry (Protective and aggressive mimicry)

IV: Types of animal behaviour

1. Innate behaviour-Taxes, reflexes, instincts, motivation.
2. Learned behaviour- Habituation, Imprinting, conditioned reflexes, insight learning.
3. Social behaviour - Types of animal society, colony in honey bees, communication in honey bees, monkey troops.
4. Biological clock - Circadian rhythm.

V Behavioural Ecology

- i. Approaches to the study of behaviour: psychological, physiological, and ethological, fixed action patterns (more complex behavioural patterns) and signalling devices, innate releasing mechanisms.
- ii. Application of ethological techniques (ethogram) to human behaviour.

VI. Reproductive behaviour

Methods in the study of hormones and behaviour (Correlation method, castration, and replacement), territoriality and aggression.

Text / Reference Books recommended :

1. Verma P.S and Agarwal B.K. (2002). Environmental Biology (Principles of Ecology). S.S. Chand and Co Publishers.
2. Sharma P.D. Ecology and Environmental Biology,
3. Arora M.P. Animal behaviour, Himalaya Publishing House, New Delhi
4. Arora M.P. (2004). Ecology, Himalaya Publishing House, New Delhi.
Price and Stoker. Animal behaviour in Laboratory and field. Freeman Publishers.
5. Drickamen and Vessey. Animal behaviour-Concepts, processes and methods, Wadsworth

- publishers.
6. P.J.B. Slater (1999). Essentials of Animal behaviour, Cambridge University Press.
 7. Pandey J. & M.S. Sharma (1999). Environmental Science, Practical and field manual. Yash Publications.
 8. Trivedy R.K., Goel P.K., Trisal C.L (1987). Practical methods in Ecology and environmental Science, Environmental Publications, Karad.

PRACTICALS:

1. a. Determination of particle size of sediment sample.
b. Determination of water holding capacity of different types of soil.
2. a. Estimation of Dissolved oxygen of given water samples (Winkler's Iodometric method).
b. Estimation of Dissolved carbon dioxide of given water samples.
3. Estimation of organic matter of soil (Walkley & Black method).
4. Identification of Zooplankton in given water sample.
5. Study of ecological adaptations:-
 - Aquatic (Ranatra, *Physalia*, Duck, fish).
 - Volant (Dragon fly, Parakeet, Bat). -
 - Desert (*Phrynosoma*, Camel, Hedgehog).
1. Study of ecological adaptations (Cont..) -
 - Cursorial (Ostrich, Tiger, Horse). -
 - Fossorial (Mabuya, Rabbit, Cobra). -
 - Parasitic (Leech, Tapeworm, *Pediculus*)
2. a. Study of chemotaxis in *Paramoecium*.
b. Study of phototaxis in Earthworm.

▣ Study of type of insect nests (Bees, Wasps, ants, termites)

▣ Study of type of bird nests.

10. Study of Eye withdrawal reflex in Crab to study habituation.

11. Film show on animal behaviour and adaptations.

General note on field work:

In addition to the regular lectures and practicals, students should undertake 2 local field trips (each of not less than eight hours duration) and a long trip of not less than 72 hrs. duration.

The field work is to be treated as 2 lecture hours per batch per week.

T.Y. B.Sc.

ZOOLOGY

T.Y. B.Sc. (SPECIAL)	
V Semester	
ZP:09	Comparative Anatomy of Vertebrates
ZP:10	Human Physiology & Biochemistry
ZLC: 01	Practicals:
	a. Comparative Anatomy of Vertebrates
	b. Human Physiology & Biochemistry
VI Semester	
ZP: 11	Applied Genetics & Evolution
ZP: 12	Basic Animal Biotechnology
ZLC: 02	Practicals:
	a. Applied Genetics & Evolution
	b. Basic Animal Biotechnology
VII Semester	
ZP: 13	Developmental Biology
ZP: 14	Endocrinology
ZLC: 03	Practicals:
	a. Developmental Biology
	b. Endocrinology
VIII Semester	
ZP: 15	Environmental Biology & Toxicology
ZP: 16	Animal Biotechnology Applications
ZLC: 04	Practicals:
	a. Environmental Biology & Toxicology
	b. Animal Biotechnology Applications
(GENERAL)	
V Term	
ZP: 17	Comparative Anatomy of Vertebrates & Histology

ZP: 18	Environmental Physiology
ZLC: 05	Practicals: a. Comparative Anatomy of Vertebrates & Histology b. Environmental Physiology
VI Term	
ZP: 19	Applied Genetics
ZP: 20	Economic Zoology
ZLC: 06	Practicals: a. Applied Genetics b. Economic Zoology

**T.Y.B.Sc.
(SPECIAL)**

CODE	CLASS	SEMESTER	TITLE
BSEDZ OO 501	T.Y.B. Sc.	V	Comparative anatomy of Vertebrates

Unit I : Skeletal System

1:1 : Concept of Chondrocranium, Dermatocranium and Splanchnocranium

1:2 : The tetrapod hyoid – Hyoid apparatus (Amphibians, reptiles, birds & mammals)
1:3 : Jaw suspension

Unit 2 : Integumentary system

3. Integument Proper : Comparative anatomy of the integument

4. Epidermal derivatives and their modifications: Glands – classification based on structure and modes of secretion. Comparative anatomy of integumentary glands. Scales, feather, hair, beaks & bills, claws, nails and floofs, horns and antlers.

7) : Dermal Derivatives – Scales and scutes.

8) : Integumentary pigments – Poikilotherms and Homeotherms.

9) : Functions of skin

Unit 3 : Respiratory system

12. Gills – types, gross idea of gills in fishes and amphibians.
13. Origin of lungs and swim bladder (functions not to be included)
14. Lungs and air ducts – Larynx, trachea and Bronchi (Gross idea in different vertebrates. Mechanism of respiration not to be included).

Unit 4 : Circulatory System

2. Heart, comparative anatomy (Cartilaginous fish, bony fish, lung fish – protopterus, frog, reptiles (calotes and crocodiles), pigeon and rabbit.
 3. Evolution of aortic arches – shark, bonyfish, protopterus, frog, calotes, pigeon, rabbit.
- 10.3 Portal circulation – Hepatic & Renal portal circulation. (mention only).

Unit 5 : Excretory System

6. Types of Kidneys – Archinephros, The Anamniote kidney – pronephros, opisthonephros – comparative anatomy of opisthonephros (cyclostomes, fishes and amphibians).
The Amniote kidney-mesonephros, metanephros, Comparative Anatomy of metanephros (Reptiles, birds and mammals.)
- 1 Urinary Bladder
 - 2 Structure of glomerulus, uriniferous tubules and maintenance of water balance kidney – structure and function.

Unit 6 : Nervous system

- 4) Primary Divisions
- 5) Central Nervous System

The brain – primary divisions, flexures, gray and white matter of brain.

Myelencephalon, metencephalon, mesencephalon, Diencephalon, Telencephalon – a comparative study in different vertebrates.

1. Peripheral Nervous System
Cranial nerves and Spinal nerves in general.
2. Autonomic nervous system in general.

Text / Reference Books recommended :

1. Romer, A. S. & Parsons, T. S. The Vertebrate Body, (New Edn.) Holt Saunder International Eds.
2. Weichert, C. K. Anatomy of the chordates. Mc Graw Hill & Co.
3. Kent, G. C. Comparative Anatomy of Vertebrates, C.V. Mosley & Co.

4. Webster, D. & Webster, M. Comparative Vertebrate Morphology published by Academic press.
5. Jordan, E. L., & Verma, P.S., Chordate Zoology (New Edn.) S. Chand & Co.
6. Dhami & Dhami – Chordate Zoology.
7. Sinha, A. K., Adhikari, S., Ganguly, B.B., Biology of Animals Vol. II New Central Book Agency, 8/1 Chintamani Das Lane, Calcutta.
8. Dr. Nigam, H.C., Biology of chordates, Vishal publications, adda hoshiarpur, Jalandhar city.
9. Prasad, S. N., Chordates, Vikas Publishing House, Pvt. Ltd.
10. Parker, A. J. & Haswell, W.A., A textbook of Zoology, Vol. II (New Edn.) Low price publications, 425, Nimri, Ashok Vihar, Phase IV, Delhi – 110052.

CODE	CLASS	SEMESTER	TITLE
BSEDZOO 502	T.Y.B. Sc.	V	Human Physiology & Biochemistry

Unit I Haematology :

Introduction, properties, Composition of blood-Inorganic and Organic.

PLASMA PROTEINS: Inorganic and organic constituents, functions

ERYTHROCYTES: Morphology, variation in numbers, functions, erythropoiesis including factors, haemoglobin , anaemia, ESR, packed cell volume.

LEUCOCYTES: morphology, types, normal count, functions, leucopoiesis, differential count

THROMBOCYTES: Structure, composition, normal count, functions, blood clotting process bleeding disorders.

(Clinical significance to be stressed wherever applicable).

Unit II Neurophysiology:

A brief introduction to human nervous system

Basic structure of neuron, synapse and its function, origin of nerve impulse, nerve action potential, synaptic transmission, Neurotransmitter (Acetylcholine in detail)- transport and release. Electro Encephalogram (EEG).

Reflex Activity: Definition, significance, reflex arc properties,

Neurophysiological bases of memory, sleep, emotion and pain.

Unit III Reproductive physiology:

Brief overview of reproduction in humans.

Fertilization, implantation, Pregnancy- placenta and its role. Maternal changes.
Parturition-stages, Role of hormones in growth of mammary gland and lactation

Unit IV Biomolecules

- **Carbohydrates:** Monosaccharides- Nomenclature, definition, occurrence, classification, optical isomerism, mutarotation, linear and ring structure of monosaccharides e.g. glucose, fructose, ribose, and deoxyribose.

Oligosaccharides- composition and biological roles of sucrose lactose, maltose.

Polysaccharides: occurrence, classification, composition and biological roles of

Homopolysaccharides- starch glycogen, cellulose, chitin,

Heteropolysaccharides- hyaluronic acid, chondroitin sulphate, heparin.

B) Proteins:

Amino acids: Structure, classification (based on R. side groups), peptides.

Chemical bonds involved in protein structure.

Protein configuration- primary, secondary, tertiary and quaternary.

C) Lipids

Lipids: definition, occurrence, broad classification, biological importance of fatty acids, simple lipids (fats, oils, waxes), Compound lipids (phospholipids, glycolipids), Derived lipids – steroids, cholesterol and its biological importance.

Unit V Enzymes:

A REVIEW OF ENZYME AS CATALYST, CHEMICAL NATURE

Michaelis-Menten equation, derivation, significance, of K_m and V_{max} , double reciprocal plots.
Enzyme activators, inhibitors (reversible and irreversible), coenzymes and isoenzymes.

Unit VI Biosynthesis of Nucleic Acids & Proteins

Biosynthesis of nucleic acids (DNA, RNA) (Eukaryotes). Protein synthesis-Transcription and translation (eukaryotes).

Text / Reference Books recommended :

1. K. Jambulingam and P. Sambulingam “essential of medical physiology”. Jaypee brothers.
2. Subramanyan Madhavan Kutty and Singh “Human physiology”
3. Mohan Arora “Animal physiology” Himalaya publishing House.
4. Albert Lehninger “Principles of Biochemistry, CBS publishers and distributors.

5. Conm, Stumpf, Bruening "Outlines of Biochemistry", John wiley
6. J.L.jain "Fundamentals of Biochemistry" S.Chand andCompany
7. V. Satyanarayana 'biochemistry books and allied (p) ltd.
8. C.C Chatterjee. Human Physiology.Allied medical publishers, Calcutta.

<i>CODE</i>	<i>CLASS</i>	<i>SEMESTER</i>	<i>TITLE</i>
BSEDZ OO 601	T.Y. B. Sc.	VI	Applied Genetics & Evolution

GENETICS

1. Gene regulation in Prokaryotes and Eukaryotes

and mutations. The 'trp' operon – structure, function and regulation (repression & attenuation).

Regulation of lysis and lysogeny.

2. Genetic recombinations – transformation, conjugation and transduction.

Transformation – Griffiths, Avery, Macleod, and McCartys, experiments.Natural and artificial transformation in bacteria.Transformation in eukaryotic cells, transposition (transposons)

3. Gene mapping and genome analysis – concept of linkage and crossing over linkage and physical mapping.

Linkage mapping – construction by using 2-3 points tests

Physical mapping - Chromosome mapping, insitu hybridization (FISH). Restriction mapping – restriction fragment, length polymorphisum (RFLP) Pulse field gel electrophoresis (PFGE)

DNA sequencing, ultimate physical mapping (Maxam Gilbert's chemical and Sanger and Coulson's enzymatic method).

4. Developmental genetics - Drosophila

Drosophila – Genes that establish the body plan – maternal effect, segmentation, homeotic genes

5. Genetics of Cancer – Familial and sporadic cancer, classes of cancer genes.

Knudson's two-hit model for retinoblastoma, cancer development is multistep process.

Prtooncogenes, oncogenes, antioncogens (Tumor suppression genes).

6. Biostatistics -

Mean, mode, median, standard deviation, standard error, correlation, regression, chi-square, tests-students 't' test, (test of significance for correlation, regression; 'F' test, Non-parametric tests, to be dealt in practicals).

EVOLUTION

1. Introduction to modern synthetic theory of evolution (Neo-Darwinism) and mechanism of Evolution. Variation : Definition, kinds, sources and role of variations in evolution; Natural selection: Definition, types, nature and working of natural selection, natural selection in action and role of natural selection in evolution. Isolation: Definition, isolating mechanism (all types) and role of isolations in evolution.
2. Concept of micro evolution, macro evolution, mega evolution
3. genetic basis of evolution – Population genetics: Gene pool, gene frequencies and Hardy- Weinberg equilibrium
4. Speciation : Definition of species and sub species category,
Allopatric and sympatric speciation,
Inter specific and intra specific speciation
5. Adaptations (all types), Divergent evolution, convergent evolution
6. Study of Fossils: Definition, formation, types and determination of age of fossils (radio-active clock method), significance of study of fossils.

Text / Reference Books recommended :

- | | | | |
|----|---|---------------------------------|----------------------------|
| 1. | Arora, P.N. and Malhan, P.K. 2003. | Biostatistics | - Himalaya Publications |
| 2. | Fair bank, D.J. and Andersen, W.R. 1999 | Genetics the continuity of life | Book / Cole publ. New York |
| 3. | Pawar, C.B. 2003 | Genetic Vol II | Himalaya Publ. |

- | | | | |
|-----|--|--|--|
| 4. | Snustad, Simmons, Jenkins, 1999 | Principles of Genetics | John Wiley & Sons
New York |
| 5. | Strick Berger 1985 | Genetics | Mc Millan |
| 6. | Sharma, A.K. and Sharma A. 1980
(3 E) | Chromosome techniques :
Theory and practice | Butter works & Co. ltd.
London |
| 7. | Benjamin Lewis | Gene I to VII | |
| 8. | Andrew, A.T. 1986 | Electrophoresis 2 nd Edition | Oxford University |
| 9. | Singer, M and Berg P. 1991 | Genes and Genomics | University of Science
books Mill way |
| 10. | Strachan, T. and Read A.P. 1996 | Human Molecular Genetics | Hillier - liss |
| 11. | Miglani G.S. 2006 | Developmental Genetics | I. K. International Publ.
House, N. Delhi |
| 12. | Singh Shailendra | Genes and Evolution | Campus book |
| 13. | V.B. Rastogi | Organic Evolution | Kedar Nath Ram Nath |
| 14. | Volpe. E.P. | Understanding Evolution | Universal Book stall |

CODE	CLASS	SEMESTER	TITLE
BSEDZ OO 602	T.Y.B. Sc.	VI	Fundamentals of Animal Biotechnology

1. Biotechnology : An Overview – Scope and Importance

2. Introduction to microbes – Bacterial identification, Nutritional types; Reproduction, Nutritional

requirement – media, maintenance of media

3. Enzymes in Genetic engineering (Nucleic acid Enzymology) Restriction enzymes - types and target sites; Ligases, Alkaline phosphatase, polynucleotide kinase, Transferase, Polymerases,

Nuclease, Reverse transcriptase

4. Recombinant DNA technology - Isolation of DNA, labeling, Probing and cloning
Genomic library - Colony hybridization, plaque hybridization, chromosome walking, chromosome jumping.

5. Genetic Engineering Techniques – Blotting Techniques – DNA by southern blotting, RNA by

Northern and Protein by Western blotting; RFLP mapping, DNA sequencing.

6. Gene cloning vectors - plasmids - Bacterial plasmids pBR 322 and its derivatives, pUC

vectors; Bacteriophage vectors, Cosmids, Phagemids, virus vectors for animal cells, shuttle and

expression vectors.

7. Genetic Engineering: Gene Cloning, Gene transfer and expressions of induced genes, -
Gene – cloning in bacteria and eukaryotes, Polymerase Chain Reaction (PCR), Gene transfer technology,

human gene therapy.

Text / Reference Books recommended :

6. Old, R.W. and Primrose, S.B. Principles of Gene Manipulation: An introduction to Genetic Engineering.
- 2) Meyers, R.A. (Edt) Molecular Biology and Biotechnology VCH Pub.
- 3) Brown T.A. 1990 Gene cloning an introduction VNR international Pub.
- 1 Purohit, S.S.2000. Biotechnology Fundamentals and Applications Agrobios India.
- 2 Wulf C and Anneliese cruega. Text book of Industrial microbiology
- 3 Prave, P. etal. Fundamentals of Biotechnology.
- 4 Tata McGraw Hill, 1993 Microbiology. Pelczar, Chan, Kreig
- 5 Dubey & Maheshwari 2004, Text Book of Microbiology S.Chand
- 6 Vinita Kale, K. Bhusari, Practical Microbiology : Principles and Techniques Himalaya

Pub. 2005

- 7 Dubey & Maheshwari. Practical Microbiology by S. Chand 2005
- 8 Sambrook, J.Fritch, E.F. and Maniatis, T. 1989 (2nd Edition) Molecular Cloning: A Laboratory manual Cold spring halfow.
- 12) Naik, G.R. 2004. Basic Molecular Biology techniques. Himalaya Publ.

CODE	CLASS	SEMESTER	TITLE		
BSEDZO O 503	T.Y.B. Sc.	V	Practicals: Comparative anatomy of Vertebrates Human Physiology & Biochemistry		

1. Comparative anatomy of Vertebrates

Observation of following skeleton specimens :

Dogfish – visceral skeleton. Cartilaginous

trunk and caudal vertebrae. Bonyfish

trunk and caudal vertebrae

Varanus – Atlas, Axis and Caudal

vertebrae. Snake – trunk vertebrae

Pigeon – cervical vertebrae,

synsacrum Rabbit – Vertebral column.

Study of girdles :

Pectoral girdles of shark, bonyfish, frog, varanus, pigeon, rabbit.

Pelvic girdles of Shark, bonyfish, frog, varanus, pigeon, rabbit.

Observation of – a) Hyoid apparatus of pigeon and rat.

Columella of pigeon.

Observation of four different types of internal gills in vertebrates

Salamander

Tadpole larva

Bony fish

Cartilaginous fish

E. Identification of heart of cartilaginous fish, bony fish, pigeon and rabbit.

F. Mounting

Chromatophores in fishes

Brain of chick

Brain of rat

G. Dissections

Heart and aortic arches of chick and rat.

Urinogenital system of chick and rat.

b. Human Physiology & Biochemistry:

1. Enumeration of Erythrocytes
2. Enumeration of leucocytes
3. Differential count of leucocytes
4. Estimation of erythrocyte sedimentation rate.
5. Estimation of blood cholesterol.
6. Separation of lipids by thin layer chromatography
7. Estimation of fatty acids by titration method
8. Colorimetric estimation of liver glycogen.
9. Colorimetric estimation of plasma glucose.
10. Effect of substrate concentration on amylase activity and determination of K_m .

Text / Reference Books recommended :

1. J. Jayaraman 'lab manual in biochemistry' new age international.
2. David Plumer 'An introduction to practical biochemistry' Tata McGraw Hills.
3. T. Poddar , Mukhopadhaya, Das 'Advanced laboratory manual of zoology' . Maemillan publication.
4. R. N. Roy 'physiology , biochemistry and biophysics' books and allied (p) ltd.
5. Agarwal and jindal 'advanced practical zoology' - pragati parkas

CODE	CLASS	SEMESTER	TITLE
BSEDZO O 603	T.Y.B. Sc.	VI	Practicals: a. Applied Genetics & Evolution b. Fundamentals of Animal Biotechnology

Applied Genetics & Evolution:

- 1) Extraction and Estimation of DNA
- 2) Extraction and Estimation of RNA
- 3) Extraction and Estimation of Protein
- 4) electrophoretic separation of DNA / RNA
- 5) Electrophoretic separation of Protein
- 6) Problems on Gene frequency (Allele frequencies) (ABO blood groups)
- 7) Problems on standard deviation, correlation, regression, chi-square, F-test, test of significance for regression co-relation. Non parametric tests.
- 8) Problems on DNA fingerprinting (fraternity test, forensic science) by using printed material / RFLP
- 9) Identification based on evolution topics – Fossils, Analogous, Homologous organs
- 10) To demonstrate the role of natural selection in evolving adaptations.
- 11) To demonstrate the role of natural selection in fixing favoured adaptations and eliminating mal-adaptation
12. An exercise to illustrate the concepts of Genetic drift.

Fundamentals of Animal Biotechnology

- 4) Introduction to microbiology laboratory - concepts of sterilization
- 5) Preparation of media, autoclaving, isolation of bacteria by streak method
- 6) Enumeration techniques: Viable count by spread plate method and Neubauer chamber
- 7) Observation of microorganisms - Negative staining, gram staining
- 8) Motility study by stab culture method.
- 9) IMViC test for pathogenic bacterial identification.
- 10) Extraction and estimation of m-RNA
- 11) Determination of the concentration and purity of DNA by UV-spectroscopy.
- 12) Isolation of plasmid DNA by alkaline lysis method.
- 13) Introduction of DNA into cells. (Demonstration)

Preparation of Frozen competent cells and their transformation.

Selection of transformed cells.
- 14) Molecular weight determination of plasmid using restriction enzymes. (Demonstration)
- 15) Restriction endonuclease digestion of plasmid DNA and agarose gel electrophoresis. (Demonstration)
- 16) Ligation of digested DNA. (Demonstration)

CODE	CLASS	SEMESTER	TITLE
BSEDZ OO 701	Fourth.Y. B. Sc.	VII	Developmental Biology

Unit 1 : Introduction

Theories of development and differentiation. Branches of embryology. Scope of embryology.

Gametogenesis -Spermatogenesis, Oogenesis, Vitellogenesis, Egg membranes. Fertilization and parthenogenesis Sperm – Egg interactions, Biochemical events, Post fertilization events.

Types of Eggs, Patterns of cleavages, Germ layers, Gastrulation, Fate maps and Cell lineage.

Unit 2 : Transplantation, embryonic inductions, concept of organiser and competence 10 c

Definition of trasnplantation, Nuclear transplantations, Embryonic induction, Types of embryonic inductions, Experimental evidence to embryonic induction, Brachets Experiment and Experiment of Spemanns and Mangold – Concept of organiser primary organizer, Characteristics of an organiser, Regional specificity of organizer, Neural induction, Mechanism of neural induction – surface interaction and chemical interaction, Gradient theory of neural induction, Secondary, Tertiary and Quarternary organizers, Eye as an example of sequential induction, Competence.

Unit 3 : Early Development of Chick

Structure of hen's egg, cleavage, blastula, Gastrulation, Origin and formation of primitive streak. Development of chick embryo upto 3 days of incubation.

Unit 4 : Extra embryonic membranes of chick

Development, structure and functions of yolk sac, Amnion, chorion and allantois.

Unit 5 : Placenta and placentation

Definition, Classification of the different types of placenta

Functions of placenta

Unit 6 : Regeneration and ageing

Types, Regenerative ability in different animal groups, Mechanism of regeneration, Stimulus and suppression of regeneration, Polarity in regeneration.

Ageing – Concepts and models.

Stem Cells

Definition, Kinds of stem cells and their unique properties.

Protocol for the preparation of Embryonic stem cells in the laboratory.

Adult stem cells – their availability and function.

Similarities and differences between Embryonic and Adult stem cells.

Application of Human stem cells.

Text / Reference Books recommended :

- Balinsky, B. I., An introduction of embryology, saunders college pub., Philadelphia.
- Berril N. J., Developmental Biology, Mc Graw Hill, New Delhi.
- Bruce M. Carlson, Patten's Foundations of Embryology 6th Edn. Mc Graw Hill, Inc.
- Gilbert, S. F., Developmental Biology, Sinauer Associates, Sunderland.
- Jain, P.C., Elements of Developmental Biology, Vishal Publications, Jalandhar-8
- Mc. Ewen, R. S., Vertebrate Embryology, Oxford and IBH publishing company, New Delhi.
- Nair, P.K.G., Achar, K.P., Principles of Animal Embryology - Himalaya Publishing House.
- Suresh C. Goel, Principles of Animal Developmental Biology, Himalaya Publishing House.
- Verma, P. S., Agarwal, V.K., Chordate Embryology (Developmental Biology) S. Chand and Company Ltd., Ram Nagar, N. Delhi.
- Waddington, C.H., Principles of Development and Differentiation, the Macmillan Company, New York.

CODE	CLASS	SEMESTER	TITLE
BSSEDZOO 702	Fourth.Y.B. Sc.	VII	Endocrinology

Unit I Introduction :

Endocrinology, endocrine glands, concept of endocrine regulation of physiological process. Hormones: classification – proteins, steroid and derived hormones. Regulation of hormonal secretion- feed back control, secretory mechanism, Role of hypothalamus. Mechanism of hormone action-protein and steroid.

Unit II Hypophysis

Gross anatomy in mammals. Histology of Adenohypophysis and neurohypophysis. Hypothalamo hypophyseal portal system, hormones of pituitary, their functions and effect on target organs.

Disorders of pituitary.

Unit III Thyroid and Parathyroid

Histology, thyroid hormones. Role of T3, T4. Thyroid disorders. Thyroid function test Parathyroid: histology, hormones, Regulation of blood calcium levels.

Unit IV Endocrine pancreas.

Microscopic anatomy, hormones (insulin and glucagon), Regulation of blood glucose levels, diabetes mellitus.

Unit V Adrenal

Adrenal cortex and medulla: functional anatomy, their hormones, regulation of secretion and biological functions of their hormones.

Unit VI Gonads

Endocrine Testis: histology, endocrine component. Regulation of testicular function. Ovary: histology, endocrine structure ovary and hormones associated with ovarian cycle.

Text / Reference Books recommended :

- Hadley: endocrinology.

- C.D Turner and J.T Bagnara. General Endocrinology W.B. saunder publications
- Eckert and Randall ‘animal physiology’ CBS publishers
- B.N. Yadav ‘mammalian endocrinology’ vishal publications.
- Ross Histlogy
- Fawcet Histology
- Bailey’s text book of microscopic anatomy.

CODE	CLASS	SEMESTER	TITLE
BSEDZ OO 801	Fourth.Y. B. Sc.	VIII	Environmental Biology & Toxicology

Unit 1: Natural resources:

Introduction, resource cycle, mineral resources (distribution of minerals, classification of minerals, mineral wealth of India, mineral resources of Antarctica, mineral production), marine living resources, energy resources (renewable and non renewable resources of energy), nuclear energy (Uranium and Thorium), forest resources, water-a vital resource.

Unit 2: Population dynamics:

Population density, natality of population, fecundity, mortality of population, life tables, age distribution of population, age pyramids, sex ratio, biotic potential and environmental resistance, growth form of population, growth rate of population, population dispersion: emigration, immigration, migration, regulation of population size.

Unit 3: Wildlife in India

Introduction, reasons for depletion of wildlife, aim and necessity for wildlife conservation, endangered, vulnerable and rare species, methods of studying wildlife, wildlife protected areas, Role of Government and NGO’s in wildlife conservation, Wildlife protection acts and legislation. Application of Remote sensing and GIS in wildlife studies.

Unit 4: Introduction to toxicology

Definition, history, and importance of toxicology, toxicants, and toxicity, disciplines of

Toxicology

Unit 5: Environmental toxicology

Classification of environmental toxicants: toxicants contaminating food, toxicants present in atmosphere and hydrosphere, sources, environmental levels and toxicity of heavy metals e.g. mercury, lead, arsenic, cadmium, definition, and classification of pesticides. Safety evaluation of chemicals (process of risk assessment and safety evaluation programme)

Unit 6: Radioactive substances

Introduction and definition of radionuclide and radioactive substances, ionizing radiation- definition and classification of ionizing radiation, electromagnetic radiation and corpuscular radiation, Alpha and beta particles, neutrons, gamma and cosmic rays, sources of radiation: natural sources, man-made sources, x-rays, radioactive fallouts, nuclear power, ore processing operations, fate of discharged radionuclide in the environment.

Text / Reference Books recommended :

- Pandey R, Shukla J.P, Trivedi S.P (2006). Fundamentals of Toxicology, New Central Book Agency.
- Omkar. Concepts of Toxicology, Shoban lal nagin chand and Co, Jalandhar, India.
- Rajesh Gopal (2000). Fundamentals of wildlife management, Justice Home.
- Verma P.S and Agarwal B.K. (2002). Environmental Biology (Principles of Ecology). S.S. Chand and Co Publishers.
- Arora M.P. (2004). Ecology, Himalaya Publishing House, New Delhi.
- Dash M.C. (1993). Fundamentals of Ecology. Tata McGraw Hill Publishers, New Delhi.
- Michael P. (1984). Ecological methods for field and laboratory investigations. Tata McGraw Hill Publishers, New Delhi.
- T. Poddar, S. Mukhopadhyay, S.K. Das (2003). An advanced laboratory manual of Zoology, MacMilan India Ltd, Mumbai.
- Gurkamal Basra: Wildlife of India, Vishvabharati publication.

<i>CODE</i>	<i>CLASS</i>	<i>SEMESTER</i>	<i>TITLE</i>
BSEDZOO 802	Fourth. Y. B. Sc.	VIII	Animal Biotechnology Applications

1. Animal Cell Culture

History; Requirements of Cell-culture; Protocols for Primary Cell Culture; Subculture; Established Cell lines (common examples such as MRC, HeLa, CHO, BHK, Vero); Organ culture.

2. Large scale production of mammalian cells.

3. Important products from cell culture: Tissue Plasminogen Activator (tPA),
Factor VIII, Erythropoietin(EPO), Growth Hormone (GH), Interferons (IFN)

4. Hybridoma Technology

Cell fusion, Production of Monoclonal antibodies (mAb), Applications of mAb

5. Vaccines – different types

6. Manipulation of reproduction in dairy animals and humans:

Artificial Insemination, *In vitro* Fertilisation , Embryo Transfer, Embryo cloning

7. Transgenic Animals

Strategies of Gene transfer; Transgenic mice, - sheep, - fish; Molecular farming

8. Applications of Biotechnology in fisheries - use of PCR in fisheries, monoculture in fishes, polyploid in fishes

9. Application in sericulture- introduction of colour genes, sex markers.

Text / Reference Books recommended :

5. A Text Book of Biotechnology By R.C. Dubey (S. Chand)
6. Animal Biotechnology M.M. Ranga (Agrobios)
7. Biotechnology By B.D. Singh

CODE	CLASS	SEMESTER	TITLE
BSEDZO O 703	Fourth Y.B. Sc.	VII	Practicals: a.Developmental Biology b.Endocrinology

a. Developmental Biology

- Observation of live gametes under microscope.
 - Observation of different types of eggs – amphibian egg, hen's egg, insect egg.
 - Observation of developmental stages of frog's egg – cleavage, blastula, gastrula.
 - Study of morphogenetic movement invivo in hen's egg using vital staining technique by preparing a window opening.
 - Invitro observation of the different extra embryonic membranes in a 6 days old chick embryo.
 - Mounting of eye vesicle and limb buds of a 6 day old chick embryo.
 - Preparation of permanent slides of chick embryo.
 - 24 hrs., ii. 36 hrs., iii. 48 hrs. , iv. 72 hrs.
- To study the regenerative ability in different animals in both invertebrates and vertebrates.
 - Primary culture of Chick Embryo – Fibroblast – Warm Trypsinization, Cold Trypsinization.

1. Endocrinology

Study of the histological slides of the following endocrine glands of mammals: thyroid, suprarenal pituitary, parathyroid, islets of langerhans, testis and ovary.

Demonstration of endocrine glands in cockroach / crustaceans.

Demonstration of surgical technique- Adrenalectomy in rats.

A general survey of endocrine glands in rats.

Study of estruous cycle by vaginal smear preparation.

Histological technique: preparation of tissue, fixing embedding, sectioning, staining and mounting of testis of rats.

Effect of oestrogen on the ovary and uterus of rat.

A visit to a fish breeding farm/Prawn culture or breeding farm and submission of a report.

Suggested References books

- K. C. Ghose and B. Manna :practical zoology new central book agency.
- S. S. Lal ‘ a text book of practical zoology (vertebrates) Rastogi publications.

CODE	CLASS	SEMESTER	TITLE		
BSEDZO O 803	Fourth Y.B. Sc.	VIII	Practicals: Environmental Biology & Toxicology Animal Biotechnology Applications		

a. Environmental Biology & Toxicology

1. Determination of light penetration by Secchi Disc method.
2. Determination of calcium and magnesium in water.
3. Determination of total alkalinity in water.
4. Determination of salinity of water sample.
5. Field estimation of animal population by quadrat method.
6. Qualitative and quantitative estimation of soil fauna.
7. Estimation of total dissolved solids in given water sample.
8. Estimation of phosphorus and nitrates in the given water sample by spectrophotometer method.
9. To determine LC 50 of mosquito larvae using suitable pollutant/toxicant.
10. Effect of pesticide on oxygen consumption in fish/bivalve.

b. Animal Biotechnology Applications

1. Raising of Antibodies.
2. Separation and collection of Serum.
3. Simple Immunodiffusion.
4. Counter Current Immunodiffusion
5. Radial Immunodiffusion. (Ouchterlony)
6. Setting up of suspension culture of spleen cells
7. Setting up a monolayer culture of Macrophages.
8. Viable count of the Given cell sample.

9. Setting up a primary culture of Chick embryo fibroblasts

i -Warm Trypsinization ii -Cold Trypsinization

General Note on Field Work: In addition to the regular lectures and practicals, the students should undertake 3 local field trips (each of not less than 8 hour duration) and a long study tour of not less than 10 days duration. The total field work is to be treated as 4 contact hours per batch per week.

ZOOLOGY (GENERAL)

CODE	CLASS	SEMESTER	TITLE
BSSEDZOO G 01	T.Y.B. Sc.	V	Comparative Anatomy of Vertebrates & Histology

Comparative Anatomy of Vertebrates :

Unit I – Skeletal System

Classification, visceral skeleton of Dogfish, comparative account of Jaw suspension, structure of a typical vertebra. Vertebral column of rabbit, pectoral and pelvic girdles of shark, bony fish, frog, varanus, pigeon, rabbit.

Unit II – Vertebrate integument and its derivations

General structure and functions of skin. Epidermal derivatives and their modifications. Epidermal glands, scales, feather, hair, beaks and bills, claws, nails and hoofs, horns & Antlers. Dermal Derivatives – Scales and Scutes

Unit III – General plan of circulation in various groups

Evolution of heart

Evolution of aortic arches and portal systems

Unit IV – Respiratory System

Comparative Account of Respiratory organs in vertebrates.

Unit V – Excretory System

- Evolution of urinogential system in vertebrate series.

Unit VI – Nervous System

Comparative anatomy of the brain in relation to its functions.

Comparative Anatomy of spinal cord.

Cranial nerves and Spinal nerves in general

Antonomic nervous system in general.

Histology

Unit I : A brief overview of general features of Vertebrate Development

Early morphogenesis, gastrulation, Differentiation and histogenesis, Major derivations of three germs layers and neural crest. The four primary tissues and their classification.

Unit 2 – Gland Epithelium : Exocrine and Endocrine glands.

Unit 3 – Bone : Structural elements (bone cells or bone matrix)

Bone architecture or endochondral bone formation and zones.

Fracture repairs

Hormonal or nutritional effects upon bone.

Unit 4 – Muscle – Types & fine structures.

Histogenesis and regeneration

Unit 5: Nerves – Histogenesis, degeneration and regeneration

**Unit 6 : Structure, function and changes caused by pathological factors of the following
human organs / glands.**

Lymphoid organs (tonsils, spleen) (Tonsillitis, splenitis)
Hypophysial pars distalis (Hypo and Hyper pituitarism)
Pancreas (Endocrine) (Pancreatitis, Diabetes)
Thyroid (Grave's Disease, Hyperplasia and Involution)
Adrenals (Cushing's Syndrome, Addison's Disease)
Gonads (Testis and Ovary) (Testicular Tumours)
Stain-leventhat syndrome.

Text / Reference Books recommended :

Comparative Anatomy of Vertebrates

4. Romer, A. S. & Parsons, T.S., The vertebrate body (New Edn.) Holt Saunder International Eds.
5. Weichert, C.K. "Anatomy of the Chordates MC Graw hill & Co.
6. Kent, G.C., Comparative Anatomy of Vertebrates, C. V. Mosley & Co.
7. Webster, D & Webster, M., Comparative Vertebrate published by Academic press.

Histology

6. Handbook of Histopathological and Histochemical Techniques CFA Culling, Butterworths, London.
7. Histology T. S. Leeson and Leeson, C. R., W. B. Saunders Philadelphia.
8. A textbook of Histology – W. Bloom & D. W. Fawcett, W. B. Saunders Co.
9. Bailey's Textbook of Histology – W. B. Copenhaver, R. P. Blunge, M. B. Bunge.
The Williams and Williams Co.
10. Practical Zoology K. C. Ghose and B. Manna New Central Book Agency (P) Ltd., Kolkata.
11. Textbook of Pathology, William Boyd, Lea and Febiger, Philadelphia.

CODE	CLASS	SEMESTER	TITLE
BSZDZOO G 02	T. Y.B. Sc.	V	Environmental Physiology

Unit I

Introduction physiological ecology

Adaptation- levels of adaptation, mechanism of adaptation, significance of body size.

Unit II

PHYSIOLOGICAL ADAPTATION TO DIFFERENT ENVIRONMENTS

Marine, fresh water, extreme aquatic environment (deep sea), pressure difference at various depths, effect of high barometric pressure, N₂ narcosis, decompression sickness.

Terrestrial life, extreme terrestrial environment (desert and arctic), parasitic habitats.

Unit III

STRESS PHYSIOLOGY

Basic concept of environmental stress and strain, elastic and plastic strain, stress resistance, stress avoidance, stress tolerance. Acclimation and acclimatization.

Unit IV

CONCEPT OF HOMOSTASIS

Physiological adaptation to osmotic and ionic stress. Osmoregulation in aqueous and terrestrial environment. Physiological response to oxygen deficit stress. Physiological

response to body exercise.

Unit V

HIGH ALTITUDE AND ACCLIMATIZATION

Introduction, barometric pressure, partial pressure, oxygen at different altitudes, changes in the body parameters at high altitude, mountain sickness. Acclimatization.

UNIT VI

YOGA, MEDITATION AND THEIR EFFECTS.

Text / Reference Books recommended :

1. Eckert and Randall. Animal physiology CBC publishers.
2. Willmer stone and Johnson. Environmental physiology
Blackwell science.
3. Knut-Schiemdt Nielsen. Animal physiology. Cambridge
4. Louw G. N. Physiological animal Ecology-Longman Harloss.
5. Bases of yoga Shri Aurobindo Ashram Pondichery.
6. Yogendra-yoga in modern life.
7. Mother- Health and healing in yoga. Aurchind Ashram Pondidherry.
8. R. C. Sobti 'medical zoology' Shoban lab. Chand company.

CODE	CLASS	SEMESTER	TITLE
BSEDZO O G 03	T.Y.B. Sc.	V	Practicals: a. Comparative Anatomy of Vertebrates & Histology b. Environmental Physiology

A. Comparative Anatomy of Vertebrates & Histology

I. Observation of skeleton specimens:

1. Visceral skeleton of Dogfish
 2. Vertebral column of rabbit
 3. Study of girdles :
- III. Pectoral girdles of – Shark, bony fish, frog, varanus, pigeon, rabbit.
 JJJ. Pelvic girdles of – shark, bony fish, frog, varanus, pigeon, rabbit.

II. Observation of Hearts: Shark, bony fish, chick / pigeon, rat.

III. Dissections : 1) Heart and aortic arches of chick

- 2) Heart and aortic arches of rat
- 3) Urinogenital system of chick
- 4) Urinogenital system of rat

IV. Study of permanent slides (mammalian tissues)

1. T. S. of long bone
2. Study of smooth, skeletal and cardiac muscle
3. T. S. of spleen
4. T.S. of thyroid gland
5. T. S. of pancreas
6. T.S. of adrenal gland
7. T.S. of testis
8. T.S. of ovary.

V. Preparation of fixatives

1. Micro anatomical fixative – Buffered formalin, bouins fluid, gendres fluid.
2. Cytological fixative: Carnoy's fluid, champy's fluid, muller's fluid.

VI.Preparation of stains

3. Ehrlich's Alum Haematoxylin
4. Deafield's Harmatoxyin
5. Acetocarmine
6. Eosin

VII.Temporary mounting of buccal mucosa, skeletal muscle, blood smear.

VIII.Histological preparation: Fixation to section cutting and staining of a suitable mammalian tissue.

B. Environmental Physiology

1. Study of permanent slides of parasitic protozoans (4 types)
2. Study of parasitic helminthes/ arthropods- their preservation staining. (4 types).
3. Ecological adaptation in animal kingdom. Physalia, Arenicola/Chaetopterus, Stick insect, leaf insect, Praying mantis, Perna, Exocoetus, Diodon/Tetradon. Racophorus/tree frog, Phrynosoma, Draco, Crow.
4. Recording of total hardness, alkalinity, total dissolved solids in water.
5. Enumeration of erythrocytes/ leucocytes.
6. Estimation of haemoglobin and preparation of haemin crystal.
7. Recording of atmospheric temperature, pressure, relative humidity and light intensity.
8. Film / VCD's/ Power point show for yoga and meditation.

Text / Reference Books recommended:

- 1 Agarwal and Jindal. Advanced practical zoology, Pragati prakashan.
- 2 T. Rodder, Mukhopadhaya, Das. An advanced laboratory manual of zoology. McMillen publication.
- 3 S.S.Lal. A text book of practical zoology (invertebrate and vertebrate)-Rastogi publicat 4.P. S. Verma. A manual of practical zoology (chordata/ invertebrates) J chand and company.

<i>CODE</i>	<i>CLASS</i>	<i>SEMESTER</i>	<i>TITLE</i>
BSEDZOO G 04	T. Y.B. Sc.	V I	Applied Genetics

1. Population Genetics: Hardy Weinberg equilibrium; factors affecting equilibrium, mutation, gene flow, Genetic selection and genetic drift.

2. Quantitative genetics: Inbreeding and Heterosis, Inbreeding depression. Broad sense and narrow senses heritability; Quantitative Trait Loci (QTL) and DNA markers.

3. Evolutionary Genetics: Speciation – Reproduction isolation, Quantum speciation; Molecular evolution – Amino acid divergence in proteins, Nucleotide divergence in DNA, Molecular clocks. Maintenance of Genetic diversity, phylogenic analysis.

4. Gene Mapping: Linkage maps using two and three points, physical mapping (DNA Sequencing) using chemicals and enzymatic methods.

5. Non-chromosomal Genomes and their inheritance: Mitochondrial and plastid genomes : Mitochondrial inheritance in animals and man; plastid inheritance in plants.

6. Human Genetics : Chromosomal and single gene disorders, Genetic counseling and engineering

7. Genetics in Medical and Forensic science - Genetic tests, DNA finger printing, human gene therapy.

8. Genetics in Agriculture and industry: Genetic Pharmacology, land reclamation, genetically modified bacteria for hazardous waste cleanup, Biosynthesis of fuels and industrial products.

9. Biostatistics : Probability, Variance, Mean, mode, median, standard deviation, correlation, regression, chi-square, tests- students 't' test, 'F' test, Nie distance,

Non-parametric tests.

CODE	CLASS	SEMESTER	TITLE
BSZDZOO G 05	T.Y.B. Sc.	VI	Economic Zoology

Pests of paddy Ex. *Leptocorisa varicornis* Fabr. (Rice Gandhi Bug)

Ex. *Pseudaletia separata* Walker (Army worm)

Pests of Sugarcane Ex. *Pyrilla perpusilla* Walker (Sugarcane leaf hopper)

Ex. *Tryporyza novella* Fabr. (Sugarcane top borer)

Pests of vegetables Ex. *Leucinodes orbonalis* Guenee (Brinjal shoot and fruit borer)

Ex. *Aulacophora foveicollis* Lucas (Red Pumpkin Beetle)

Pests of Fruits Ex. *Idiocerus atkinsoni* Lethierry (Mango Leaf Hopper)

Ex. *Cosmopolites sordidus* Germer (Banana Weevil)

Pests of Coconut, Palm Ex. *Oryctes rhinoceros* (Rhinoceros Beetle)

Ex. *Rhynchophorus ferrugineus* Olivier (Red Palm weevil)

(Distribution, food plants, life-history, damage caused, prevention and control measures of the insect pests to be dealt)

Unit 2: Apiculture:

Introduction, species of honey bees, social organisation and life history of honey bees; selection of bees for apiculture, methods of bee keeping (indigenous and modern methods), products of bee keeping (honey and bee wax), bee keeping as an industry.

Unit 3: Fish and Fisheries:

1. Culture fisheries: - Introduction to fish culture, types of cultivable species. Freshwater fish culture technique and management of fish culture farm, harvesting and marketing.
2. Capture fisheries: - Commercially important fisheries of Goa (Mackerel, Sardines, Seer fish, prawns, cuttle fish). Fishing tools-crafts and gears. Preservation and processing of fish and fisheries.

Unit 4: Poultry:

Introduction, habitat of fowl: food and feeding of fowls- breeds of fowls (indigenous and exotic breeds); eggs and hatching, rearing of chickens; poultry products (eggs and meat); by-products of poultry.

Unit 5: Dairy industry:

Introduction- breeds of dairy animals (cow, buffalo, goat); Milk: processing of milk, marketing and distribution of milk, milk products (Curd, cream, Butter, Ghee, khoya, cheese).

Unit 6: Role of animals in pharmaceuticals

Introduction, Immunization, and serum theory; animal oriented medicines; advancement in pharmaceuticals.

Text / Reference Books recommended :

1. Venkitaraman. Economic Zoology, Sudarshan Publishers.
2. Shukla and Upadhyaya (2002). Economic Zoology, Rastogi Publishers
3. Jabde Pradip V (2005). Textbook of applied Zoology, Discovery Publishing House, New Delhi.
4. Ahsan Jawaid, Sinha Prasad S. (2000). A handbook on Economic Zoology. S. Chand and Co.
5. Yadav Manju (2003). Economic Zoology, Discovery Publishing House.

<i>CODE</i>	<i>CLASS</i>	<i>SEMESTER</i>	<i>TITLE</i>
BSZDZOO G 06	T. Y.B. Sc.	V I	Practicals: A. Applied Genetics B. Economic Zoology

A. Applied Genetics:

1. Genetic problems:

- a. Population Genetics - Gene frequencies - Blood groups and others
 - b. Quantitative Genetics - Heritability (QTL)
 - c. Gene mapping - Linkage and physical (DNA sequencing)
 - d. Non-chromosomal inheritance
2. Human pedigree analysis
 3. Problems based on – standard deviation, correlation, regression, chi-square, Nie distance, 't' test, 'f' test, phylogenetic analysis
 4. Extraction and estimation of DNA
 5. Extraction and estimation of RNA
 6. Extraction and estimation of protein
 7. Electrophoretic separation of DNA, RNA & Protein
 8. Specimens of Genetically modified products - Fruits, vegetable, animals (transgenic animals and plants)

B. Economic Zoology

1. Identification and study of vegetable and fruit pests. (At least two each)
2. Identification and study of coconut and sugarcane pests. (At least two each)
3. Study of modification of legs and mounting of sting apparatus of Honey Bee.
4. Identification of cultivable species (fish, prawn, crab, lobster, clams, mussels and oysters)
5. Study of ornamental fishes.
6. Study of different types of formulated feeds used in poultry.
7. Platform tests for determining quality of milk.
8. Determination of acidity of milk (Lactic acid).

9. Detection of adulterants in milk.

10. Study of medicinal products of animal origin (honey, silkworm chrysalis, termite queen, sacred chank, window pane oyster, cobra venom, cod-liver oil)

General Note on Field Work: In addition to the regular lectures and practicals, the students should undertake 2 local field trips (each of not less than 8 hour duration) and a study tour of not less than 5 day duration. The total field work is to be treated as 2 contact hours per batch per week.

All the corollary courses and the project work recommended by the Newman Fernandes committee/The University will also be the integral part of the curriculum for the undergraduate programme.

EDUCATION COMPONENT

Semester I

BSBAEDU 05: School and Classroom Management

Course Objectives

- To enable students to understand the use of management principles for improving quality of education at secondary level
- Understand the managerial practices in school- human and physical resources management.
- Understand importance of classroom management
- Describe approaches to classroom management
- Understand ways of preventing problems in managing a classroom
- Explain the role of teachers and the principal in ensuring a vibrant school and classroom climate

Unit 1 School management

- 1.1 Concept of quality management and excellence in education
- 1.2 Managing Human resources
- 1.3 Concept and training of human resource development,
- 1.4 Concept of leadership, Styles of leadership
- 1.5 Functions and qualities of a) teacher b) Headmaster
- 1.6 Managing Physical resources

- Physical resources in a school - physical space (building) with adequate classroom space, adequate furniture, learning resources such as the labs, library, sports field, and staffrooms, rest rooms, etc.
- 1.7 Management of physical resources - Cleanliness, appropriate use of each with an intent or schedule
 - Streamlining ways of using the facilities: coordination, sharing
 - School records, Kinds of school records, School Calendar, Log book, Cash book, cumulative record,
- 1.8 Minimum requirements of physical and human resources in secondary schools as per Goa Education Act, RTE and other rules applicable for secondary school teachers in Goa.

Unit 2 School and Classroom Environment

- 2.1 School as an institution with an environment of its own
- 2.2 Leadership style of the headmaster and its influence on teacher role performance
- 2.3 Factors affecting school environment - goodwill, acceptance, belongingness, openness, orderliness, and access, both among teachers and between teachers and students
- 2.4 Promoting self-esteem among students
- 2.5 Team work and transparency in functioning among teachers
- 2.6 Classroom climate – concept and components.
- 2.7 Factors affecting classroom climate
- 2.8 Classroom climate and pupil achievement.

Unit 3 – CLASSROOM MANAGEMENT

- 3.1 Preparing for effective Classroom management
- 3.2 Elements of effective classroom management
- 3.3. Preventive Classroom management- Establishing Rules and Procedures, Teaching Rules and Procedures, Dealing with external disruptions, maintaining momentum during the lesson.
- 3.4 Techniques of preventive Classroom management

Unit 4-Managing Inappropriate Behaviour

- 4.1 Causes of pupil Misbehavior
- 4.2 Dealing with inappropriate behavior
- 4.3 Assertive Discipline
- 4.4 Working towards Self-management

References

- 1) Arends, Richard. (1998) learning to Teach (4th Ed), New Delhi, Mc Graw Hill.

- 2) Alka, Kalra (1977) *Efficient School Management and Role of Principals*, APH Publishing Corporation, New Delhi.
- 3) Agarwal . J C, *School Organisation , Administration and Management*, Doba House , Delhi.
- 4) Biehler and Snowman. (7th ed) (1993) *Psychology Applied to Teaching*. Boston:Houghton Mifflin Company
- 5) Buch, T (et al) (1980) *Approaches to School Management*, Harper & Row Publishers,London.
- 6) Campbell, R F., Corbally, J E and Nystrand, R O (1983) *Introduction to Educational Administration*, (6th ed), Allyn and Bacon, Inc., Boston Blumberg, A & Greenfield, w (1986) *The effective principal*, Allyn & Bacon, London.
- 7) Daniel Muijs and David Reynolds(2007) *Effective Teaching* , 3rd Edition,Sage Publication Ltd, London
- 8) Gupta, S K and Gupta S (1991) *Educational Administration and Management*, Manorama Prakashan, Indore.
- 9) Good L. Thomas and Brophy E.Jerry(1987)*Looking in Classrooms*, Harper and Row publishers,New York.
- 10) Khan, M S (1990) *Educational Administration*, Asia, Publishing House, New Delhi.
- 11) Naik, J P (1970) *Institutional Planning*, Asia Institute for Educational Planning and Administration, New Delhi.
- 12) Rai B.C , *School Organisation and Management* , Prakashan Kendra, Luknow
- 13) Sushi, T et al (1980) *Approaches to school management*, London : Harper & Row
- 14) Vashist, Savita (Ed)(1998) *Encyclopedia of School Education and Management*, New Delhi, Kamal Publishing House.
- 15) Wootan.C.Frederic(2010) *No fear in my classroom*, Aadam's media, Avon, Massachusetts.

Semester II

BSBAEDU 04: TEACHING: APPROACHES AND STRATEGIES

On completion of the course the student teacher will be able to

- Demonstrate his/her understanding of the changing concept of teaching
- Understand the relationship between teaching and learning
- Use instructional skills/strategies effectively.
- Use reflective practices in improving teaching and learning

Unit 1 Understanding Teaching

- Changing concept of teaching, teaching different from training and indoctrination, teaching as a planned activity.
- Teachers 'assumptions on teaching and its impact on planning and teaching.
- Impact of one's own socialization process on 'becoming a teacher and its limitation(impact of their early experiences as student , as student teacher)
- Proficiency in teaching: Skills, Competencies and Commitment.

Unit 2. Instructional approaches and strategies

- Teacher Controlled Instruction-Lecture method, Demonstration, Team teaching and Activity based instruction.
- Learner Controlled Instruction-Self learning, Forms of self learning-Programmed Instruction, Computer Assisted Instruction, and Project based learning.
- Small group and Whole group Instruction: Cooperative learning , Brain storming, Role play, Dramatization, Group discussion, Simulation, Debate, Quiz and seminar

Unit 3. Developing self study strategies in students

- Importance of developing study strategies in students
- Types of learning strategies
- Rehearsal strategy: underlining , marginal notes
- Elaboration strategies: Note taking, Use of analogies,PQ4R method.
- Organization strategies: Outlining, Mapping Mnemonics, Chunking, Acronyms, Link words.
- Meta-cognitive strategies: Direct Instruction and reciprocal teaching

Unit 4. Reflective Practice in Teaching

- Meaning of Reflective teaching.
- Characteristics of a reflective teacher
- Process of Reflection- Journal/ Diary writing, Self evaluation/reflection, Learner achievement as a feedback for evaluating teacher effectiveness.
- Developing a personal philosophy of teaching
- Limitations of reflective practices.

References:

1. Arends, Richard, I (1998) learning to Teach (4th Ed), New Delhi, Mc Graw Hill.
2. Malderez Angi and Wedell Martin (2007) Teaching Teachers, London, Continuum.
3. Martinez-Pons, Manuel(2001) The Psychology of teaching and Learning, London, Continuum.
4. Norton, Lin S.(2009) Action Research in Teaching and Learning, London, Routledge.
5. Overall Lyn and Sangster Margaret (2003) Secondary Teachers' Handbook (2nd Ed) London, Continuum.
6. Pollard Andrew (2006) Reflective teaching, 2nd Edition , London, Continuum.
7. Reynolds David (2011) Effective Teaching (3rd Ed), London, Sage.
8. Rowntree Derek (1986) teaching through Self Instruction, London, Kogan Page.

SEMESTER III

BSBAEDU 12: Action Research

Objectives:

After going through the course the teacher trainees will

- Understand the concept of action research
- Understand the importance of action research
- Learn how to maintain and use a research diary
- Able to prepare an action research plan
- Acquire the knowledge of collecting, analyzing and interpreting data.
- Acquire the knowledge of research report writing

Unit 1: Selecting an Action Research Problem

1.1 Meaning and characteristics of Action research

1.2 Difference between Action research and Educational research

1.3 Need of action research in schools.

1.4 Sources of research problems

1.5 Characteristics of a researchable problem

1.6 Role of research diary in selecting and defining a research problem

- Suggestions for writing research diary
- Entries in a research diary- observation, feeling, reaction, interpretation, reflection, ideas and explanation

1.7 Preparing a research plan: need and components

Unit 2: Methods of Action Research

2.1 Designs of research: Experimental action research (Pre-test Post test one group design),

Survey research and Case study

2.2 Data gathering Instruments

2.2.1 Observation

- Developing observation schedule
- Its advantages and limitations

2.2.2 Interview

- Types (structured, unstructured, and focused group)
- Developing interview schedule
- Stages of conducting interview
- Advantages and limitations

2.2.3 Questionnaire

- Types of questions (Open ended, closed ended)
- Designing questionnaire
- Advantages and limitations

Unit 3. Data Analysis and Interpretation

3.1 Quantitative data analysis

3.1.1 Frequency counts, Percentage, Mean, Standard Deviation: their use only)

3.1.2 Correlation

- Rank difference method and product movement method of calculation
- Interpretation of correlation

3.2 Analyzing qualitative data from open ended questionnaire, observation and interview

Unit 4: Writing the Action Research Report

4.1 Format of a research report

4.2 Style of writing research report

4.3 Use of tables and figures

4.4 Use of quotations and citation

4.5 Writing Bibliography

References:

1. Altrichter H., Posner P. and Somekh B.(2000) *Teachers investigate their work*, New York: Routledge.
2. Denscombe M (1999) *The Good Research Guide*, New Delhi: Viva Books.
3. Denzin N.K. and Lincoln Y.S. (2000) *The SAGE Handbook of Qualitative Research*, London: SAGE.
4. Hopkins D. (1997) *Improving Education through Action Research*, CA: Crown Press.
5. McNiff J., Lomax P. and Whitehead J. (2000) *You and Your Action Research Project*, New York: Routledge.

6. Miles M.B. and Huberman A.M. (1994) *Qualitative Data Analysis*, London: SAGE.

BSBAEDU 14: A) LIFE SKILLS

INTERPERSONAL SKILLS

- a) Characteristics of social skills
- b) Practicing social manners and mannerisms that appeal to healthy personal relationships
- c) Conflict Management

COOPERATION, TEAM-WORK AND LEADERSHIP SKILLS

- a) Meaning of cooperation and team-work -ability to work effectively and respectfully with diverse teams making necessary compromises to accomplish a common goal
- b) Cooperation versus Competition
- c) Characteristics of a team-player and Leader - assume shared responsibility for collaborative work, and value the individual contributions made by each team member
- d) Influencing and Persuasion

SELF-MANAGEMENT SKILLS

- a) Maintaining a reflective diary.
- b) SWOT Analysis
- c) Using SWOT analysis to measure present status and plan future action.

STRESS MANAGEMENT

- a) **Managing feelings** (Anger, grief and anxiety, loss, abuse, trauma)
- b) **Managing stress** (Time management, Positive thinking, Relaxation techniques)
- c) Self evaluation / Self assessment / Self-monitoring

CODE OF CONDUCT

- a) Integrity and ethical behavior in using influence and power; in personal, workplace, and community contexts
- b) Acting responsibly with the interests of the larger community in mind demonstrating ethical behavior

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SEMESTER IV

BSBAEDU 03: LEARNING RESOURCES

Objectives:

The student develops an understanding about

1. the significance of communication in the teaching-learning encounter
2. facilitative and inhibitive factors and ways to enhance/overcome them
3. the role of audio, visual and audio-visual learning media
4. self-learning and methods to employ
5. the role of a teacher in designing learning materials based on curricular objectives

6. ICT as an integral part of modern day facilitative learning
7. new technologies which accelerate learning knowing that the modern learner is a 'digital citizen'
8. managing the learning resources in a school to maintain and sustain learning
9. the significance of hands-on learning to foster learning

Unit 1. Educational Communication

1.1 Concept of Communication

- Meaning
- Components
- Communication cycle
- Types (verbal and non-verbal: meaning, characteristics, merits and limitations)
- Modes (speaking, writing, visualizing)

1.2 Significance of communication in teaching-learning

- Reflective communication (both the teacher and student)
- Interpersonal communication

1.3 Classroom communication – an analysis of its facilitative and Inhibitive nature

- Strategies to enhance communication
- Strategies to overcome inhibitive factors

1.4 Abstractness or concreteness provided by different learning experiences

- Meaning of learning experiences
- Dales cone of experiences
- Using Multiple Intelligences to plan effective communication materials

Unit 2 Multisensory Learning Media for Classroom Teaching

(Meaning, characteristics, selection, guidelines for use, merits and limitations of the following learning media)

2.1 Classification of learning media as audio, visual and audio-visual media

2.2 Audio media

- Disc based audio,
- educational radio,
- audio conference,
- podcasts, and;
- streaming audio

2.3 Visual Media

- 2.3.1 Print media (illustrated books, magazines, newspapers, periodicals, comic strips, cartoons and encyclopedia)

- 2.3.2 Projected media (digital visualizer, films)
- 2.3.3 Non-projected media (graph, map, chart, poster, images, diagrams, models and material)
- 2.3.4 Three dimensional media (realia, 3D models, specimens, puppets)

2.4 Audio-visual Media

- streaming video,
- Television/Educational Television,
- COMPUTER

Unit 3 Resources for promoting Self-learning and Learning to Learn Skills

- 3.1 Concept of learning to learn skills: self-learning
- 3.2 Principles of self – learning
- 3.3 Methods to promote self-learning (Computer Aided Instruction using ready-to-use learning packages, personalized system of instruction, learning centers, mini courses, modular instruction)
- 3.4 Merits and limitations of self-learning

Unit 4 Designing Self-learning materials (the ADDIE model to be applied in the design process)

- 4.1 Concept, characteristics and importance of designing self-learning materials
- 4.2 Steps in designing worksheets
- 4.3 Steps in designing 3D objects/models
- 4.4 Steps in designing a self-learning material (create a video material using FOSS)
- 4.5 Role of the teacher in designing self-learning materials
- 4.6 Designing a checklist to measure the effectiveness of the created self-learning material

Unit 5 Technology Enhanced Learning

- 5.1 Educational media and technology standards: SITE, ISTE, AECT
- 5.2 E-learning: Concept, Approaches (Enhanced Approach also known as face-to-face F2F, Blended Approach and Online Approach), merits, limitations
- 5.3 ICT and Multimedia as technology enhanced communication devices in teaching-learning
- 5.4 Impact of ICT on learning and achievement- national and local scenario
- 5.5 Computer as a learning resource for presentation, documentation, word processing, evaluation
- 5.6 Internet as an Information Resource: Characteristics, merits and limitations
- 5.7 Concept, characteristics and guidelines to use offline and online resources in teaching
- 5.8 Types of digital resources (simulations, educational games, tutorials, drill and practice, encyclopedia). Their characteristics, guidelines for use, merits and limitations

- 5.9 An introduction to Free and Open Source Software (FOSS)
- 5.10 Types of FOSS that can be applied to education (audio, visual, audio-visual)

Unit 6 Emerging Technologies to facilitate learning

- 6.1 Meaning, characteristics, merits and limitations of the following technologies. A practical demonstration on using cellular phones, audio/video streaming/social media/cloud storage in teaching must be compulsorily undertaken.
 - Interactive/Smart boards
 - Cellular phones
 - Collaborative learning through wikis, LMS (Moodle)
 - Language lab
 - Social media
 - Cloud storage
 - Virtual tours/field trips
 - Videoconferencing (VC)
 - Webconferencing (WC)
- 6.2 Role of the teacher in an ICT enabled environment
- 6.3 Managing School Learning Resources
 - Learning resources in a school: laboratories, IT laboratory, library (need, characteristics)
 - Managing the use of these resources: Role of the teacher

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SEMESTER V

BSBAEDU 01: FOUNDATIONS OF EDUCATION

Objectives:

By the end of the course the student-teacher will be able to:

- understand how education derives its relevance from social, cultural, economic and political contexts.
- identify the contribution to education of western and eastern thinkers.
- understand the relationship between education and development : at individual and national levels.
- examine the changing emphases on Education in the context of Globalisation, Liberalisation and Privatisation.
- develop an insight into educational funding.
- understand the importance of universalisation of secondary education and the constitutional provisions for realizing it.
- identify the various causes for inequality in schooling.

- realize the importance of Right to Education and the provisions made for realizing it.
- develop the skills required to contribute towards a Knowledge Society.
- understand the importance of educational planning and administration.
- understand the need and importance of education for peace and the national and international efforts towards it.
- explore the strategies for sensitising the learners towards environmental conservation.

Unit-1: The Social, Cultural and Political Contexts of Education

- 1.1 Sources of the Aims of Education: - social, cultural, economic and political contexts and their impact on education.
- 1.2 Education as an instrument of Social Change.
- 1.3 Socialisation - influence of society, family, peer groups, media and new age technologies on education.
- 1.4 Emerging trends in societies and their repercussions on education: liberalisation, privatisation, globalisation and internationalisation of education.
- 1.5 The Right to Education Act of 2009.
- 1.6 Educational Provisions in the Constitution of India

Unit-2: Contributions of Great Educators

The contributions to education of:

- 2.1 Jean Jacques Rousseau,
- 2.2 John Dewey,
- 2.3 Rabindranath Tagore,
- 2.4 Swami Vivekananda,
- 2.5 Mahatma Gandhi,
- 2.6 Jiddu Krishnamurthy
- 2.7 Paulo Freire

Unit 3: Education and Development

- 3.1 The Evolving Concept of Development.
- 3.2 The Right of the Child Act of 2005
- 3.3 Equity and Equality in Education – meaning, nature and forms of inequality (i) dominant and minor groups (ii) gender (iii) public and private schools (iv) rural and urban schools.
- 3.4 The Elusive Triangle of Indian Education: Equality, Quantity and Quality.
- 3.5 The Financing of Education
- 3.6 Educational Planning and Administration.

Unit-4: Education in a 'knowledge society'

- 4.1 Nature of knowledge in education: concepts, statements, educational viewpoints, metaphors and theories.
- 4.2 Emerging knowledge base in education for a 'Knowledge Society'.
- 4.3 Promoting an interdisciplinary approach to education.
- 4.4 Shift in learning environments: Unimodal to multi-mediated, school based to community linked, and real to virtual learning environments.
- 4.5 The open-distance learning environment.
- 4.6 The teacher as a knowledge worker.

Unit 5: Contemporary Concerns and Issues in Secondary Education

- 5.1 Universalisation of Secondary Education (USE): issues and concerns
- 5.2 The Salient Features of UNESCO's Education Commission Report: Education in the 21st Century (Jacques Delors)
- 5.3 Population Education
- 5.4 Education of the marginalised.
- 5.5 The importance of promoting "secularism" in education.
- 5.6 Pluralism in Education.

Unit 6: The Education System in Indian Society

- 6.1 Role of Government of India in Education
- 6.2 The policies framed by the Central Advisory Board of Education (CABE)
- 6.3 The perspective of education for national development in: the Education Commission (1964-66),
- 6.4 The NPE 1986, The Ramamurthi Education Commission 1990 and the modified NPE 1992 with its (POA)
- 6.5 Updating the National Curriculum Framework (NCF) by NCERT.
- 6.6 The Teacher's Commitment to (i) the learner, (ii) the society, (iii) the profession and (iv) the basic values.

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SEMESTER VI

BSBAEDU 09: ASSESSMENT AND EVALUATION

Objectives:

1. The student teachers will be able to understand the nature of assessment and evaluation and their role in teaching-learning process.
2. Understand the perspectives of different schools of learning on learning assessment
3. Realise the need for school based and authentic assessment
4. Examine the contextual roles of different forms of assessment in schools
5. Understand the different dimensions of learning and the related assessment procedures, tools and techniques
6. Develop assessment tasks and tools to assess learners performance
7. Analyse, manage, and interpret assessment data
8. Analyse the reporting procedures of learners performance in schools
9. Develop indicators to assess learners performance on different types of tasks
10. Examine the issues and concerns of assessment and evaluation practices in schools
11. Understand the policy perspectives on examinations and evaluation and their implementation practices
12. Traces the technology bases assessment practices and other trends at the international level

Unit 1 Perspectives on Assessment and Evaluation

- 1.1.1 Meaning of Assessment, Measurement, Tests, Examination, Appraisal, and Evaluation and their interrelationships
- 1.1.2 Difference between 'true ability' and 'observed ability', Principles of assessment and evaluation
- 1.1.3 Objectivist and Constructivist approach to assessment
- 1.1.4 Purposes of Assessment: Prognostic, Monitoring of Learning, Providing Feedback, Promotion, Placement, Certification, Grading and Diagnostic
- 1.2 Classification of assessment: based on purpose (prognostic, formative, diagnostic and summative) scope (teacher made, standardized), attribute measured (achievement, aptitude, attitude, etc.), nature of information gathered (qualitative, quantitative), mode of response (oral and written; selection and supply), nature of interpretation (norm referenced, criterion referenced) and context (internal, external)
- 1.3 Concept of Continuous comprehensive Evaluation
- 1.4 School based Assessment and Authentic Assessment.

Unit 2 Assessment of Learning

- 2.1 Dimensions of learning: cognitive, affective and performance
- 2.2 Assessment of cognitive learning: types and levels of cognitive learning: understanding and application; thinking skills –convergent, divergent, critical, problem solving, and decision making; items and procedures for their assessment

- 2.4 Assessment of affective learning: attitude and values, interest, self-concept; items and procedures for their assessment
- 2.5 Assessment of Performance: tools and techniques for assessment of skills
- 2.6 Grading: Concept, Types, Grading as practised in the schools of Goa.

Unit 3 Assessment for Learning

- 3.1 Assessment information as an input for learning, meta-cognition and development – need for continuous formative and diagnostic assessment
- 3.2 Use of Projects, Assignments, Work sheets, Practical work, Performance based activities, Seminars and Reports as assessment devices
- 3.3 Developing Performance Tasks (Subject Specific)
- 3.4 Assessment of Group Processes - Collaborative/Cooperative Learning and Social skills
- 3.5 Portfolio Assessment – its meaning, scope and uses;
- 3.6 Planning, development and assessment Self, Peer and Teacher Assessments

Unit 4 Construction of achievement tests.

- 4.1 Instructional Objectives (Revised Bloom's Taxonomy)
- 4.2 Consideration of what and why to assess (content and objectives)
- 4.3 Differentiation between instructional, learning and assessment objectives
- 4.4 Stating of Assessment Objectives - Need for integrated objectives.
- 4.5 Deciding on the nature and form of assessment - oral tests and written tests; open book examination; weightage to content, objectives, allocation of time; Preparation of a blueprint, question wise analysis,
- 4.6 Construction/selection of items; Guidelines for construction of test items:
- 4.7 Essay type: Extended response and restricted response types
- 4.8 Objective types-Alternate response, multiple-choice and matching exercises.
- 4.9 Assembling the test items, Guidelines for test administration

Unit 5 Scoring, Analysis and Reporting of Assessment

- 5.1 Scoring procedure – manual and electronic; Development of Rubrics
- 5.2 Analysis and Interpretation of Students' Performance: Norm Referenced Interpretations and Criterion Referenced interpretation
- 5.3 Processing test performance: calculation of percentages; measures of central tendency ; measures of variability- Range and Standard deviation,; graphical representations; and interpreting performance
- 5.4 Reporting Student Performance – content and formats; Progress reports- Remarks/Comments by teachers on students' performance , Cumulative records, Profiles, and Open house
- 5.5 Using feedback for reporting to different stakeholders – students, parents, and administrators

5.6 Use of Feedback for teachers' self-improvement

Unit 6 Issues, Concerns and Trends in Assessment and Evaluation

- 6.1 Existing Practices: Unit tests, half- yearly and annual examinations, semester system, Board examinations and Entrance tests, State and National achievement surveys
- 6.2 Management of assessment and examinations wrt CCE, Use of question bank
- 6.3 Issues and Problems: Marking Vs Grading, Non-detention policy, Objectivity Vs Subjectivity in assessment.
- 6.4 Impact of entrance test and public examination on teaching and learning – the menace of coaching
- 6.5 Policy perspectives on examinations and evaluation: Recommendations in National Policies of Education and curriculum frameworks
- 6.6 Trends in assessment and evaluation: Online examination, Computer-based examination, Open book exam, Exam on demand(meaning and uses only)and other technology based examinations
 - Standards based assessment – international practices

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SEMESTER VII

BSBAEDU 02: LEARNER AND LEARNING

Objectives:

After going through the course the teacher trainee will:

1. Understand the growth and development of the learner through the different stages of Childhood and Adolescence and its importance in the learning process.
2. Develop an understanding of areas of Individual Differences among learners.
3. Develop an understanding of exceptional learners and with Differently abled learners.
4. Develop an understanding of skills for handling Exceptional learners and Differently abled learners.
5. Understand the concept of adjustment, maladjustment and the causes of maladjustment.
6. Develop understanding about factors affecting learning
7. Understand the concept of learning process
8. Understand and apply the different learning theories in the classroom.
9. Understand the role of Guidance and Counseling.
10. Develop the skill in the use of psychological tests and performing experiments

Unit 1: Learner as a Developing Individual (Childhood and Adolescence)

- 1.1 Concept of growth and development: principles, role of heredity and environment
- 1.2 Developmental characteristics of the learner, developmental tasks and their implications (physical, cognitive, social, emotional and moral aspects).
- 1.3 Contemporary concerns: physical appearance, sexuality, drug abuse, ragging, peer influence, suicide, negative impact of media)
- 1.4 Role of teachers and parents in handling adolescents.

Unit 2: Understanding Learner Diversity

- 2.1 Individual Differences: Meaning and Types.
- 2.2 Areas of Learner differences with regard to: learning styles, attitude, aptitude, personality, interest, values, intelligence and creativity.
- 2.3 Understanding Differences: Meaning, identification and educational provisions for
 - Exceptional Learner (gifted, slow learners)
 - Differently-abled Learner.
- 2.4 Educational Implications of the following:
 - Jean Piaget: Cognitive Development
 - Daniel Goleman: Emotional Intelligence
 - Howard Gardner: Multiple Intelligences
 - Lawrence Kohlberg: Moral Development

Unit 3: Learning (20%)

- 3.1 Concept and nature of the Learning Process
- 3.2 Relevance of Learning Theories and Classroom implications:
 - Trial & Error learning and laws of learning
 - Classical conditioning
 - Operant conditioning
 - Gestalt
 - Gagne's hierarchy of learning.
 - Social Learning theory
- 3.3 Constructivist Approach to Learning

Unit 4: Factors Influencing Learning and Classroom implications

- 4.1 Perception (Sensation, Processes- *selection, organization, interpretation*) and Attention
- 4.2 Motivation (Concept, Types: intrinsic & extrinsic motivation, strategies to motivate students)
- 4.3 Transfer of Learning
- 4.4 Problem Solving
- 4.5 Thinking: Critical and Creative

Unit 5: Learning through Information Processing

- 5.1 Structure of Information Processing- (Sensory Register, Short Term Memory, Long Term Memory)
- 5.2 Memory Process - registration, retention, recall and recognition
- 5.3 Forgetting- causes
- 5.4 Classroom implications: ways of enhancing memory

Unit 6: Development of an Integrated Personality

- 6.1 Adjustment vs. Maladjustment: Meaning and Characteristics
- 6.2 Adjustment Strategies.
- 6.3 Characteristics of an Integrated Person.
- 6.4 Role of Guidance and Counseling in the development of an integrated personality
- 6.5 Role of Teachers and Parents in the area of Guidance and Counseling Services

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SEMESTER VIII

BSBAEDU 11: Inclusive Education

Objectives:

By the end of the course, the student will be familiar with,

- a) The philosophy of inclusive education
- b) The legal provisions for inclusive education (international and national)
- c) Challenges faced by children with disabilities (five disabilities specified)
- d) Curriculum modifications necessary to include children with disabilities mentioned in the paper
- e) Creating an inclusive environment in the school

Unit 1: Concept of Inclusive Education

1.1 Historical background of Inclusion

- a) Normalization
 - b) Models of Inclusion (Medical, Social – Rights based Approach)
- 1.2 Definition & Principles of Inclusive Education
- 1.3 Benefits of Inclusive Education
- 1.4 Challenges of Inclusive Education (Disability specific)
 - a) Attitudinal
 - b) Environmental
- 1.5 Inclusive Education – Rights Based Model
 - a) International Perspectives of Inclusive Education (UNCRPD 2006, UNESCO)
 - b) National Perspectives of Inclusive Education (NPE 1986, Inclusive Educational Program and Schemes, RTI Act)
 - c) State Level Perspective of Inclusive Education (Goa Children's Act 2003)

Unit 2: Types of Disabilities: Characteristics and Educational Challenges

- 2.1 Specific Learning Disability
- 2.2 Sensory Impairment
 - a) Hearing Impairment
 - b) Visual Impairment
- 2.3 Autism
- 2.4 Scholastic Backwardness
- 2.5 Locomotor Disabilities
 - a) Cerebral Palsy
 - b) Muscular Dystrophy

Unit 3: Curriculum Modification

- 3.1 Text Book Modification
- 3.2 Differentiated Instruction
- 3.3 Alternative Evaluation System
- 3.4 Adaptation of co-curricular activities
- 3.5 Alternative subject Choice

Unit 4: Modifying School for Inclusive Education

- 4.1 Sensitization
- 4.2 Physical structure
- 4.3 Life Skills Resource Rooms
- 4.4 Academic Skills Resource Rooms
- 4.5 Social Inclusion

References:

1. Das and Das. (2013) *Inclusive Education: A contextual working model*: Concept Publication Co.
2. Inclusive Education : Orientation Package for Teacher Education NCERT
3. Hegarty, S (2002). *Education & Children with Special Needs: From Segregation to Inclusion* Sage Publications
4. LoremanT, Depler J, Harvey D. (2005)*Inclusive Education: A Practical Guide to Supporting Diversity in the Classroom*. Psychology Press,
5. Jha, Mohan M. (2000). *Schools, 2002Without Walls: Inclusive Education For All*, Pearson Education
6. NCERT – Review of Existing Instructional Adaptations
7. Norwich B. (2000), *Dilemmas of Difference, Inclusion and Disability: International Perspective on Future Directions*, RoutledgeFalmer
8. Clough P, Corbett J, (2000). *Theories of Inclusive Education: A Student's Guide*, Athenaeum Press Limited
9. NindM,RixJ, Sheehy K, Simmons K, (2005). *Curriculum Pedagogy in Inclusive Education: Values into Practice*, RoutledgeFalmer

EDU VI: CAPACITY DEVELOPMENT

INSTRUCTIONS:

SKILL COURSE III: CLASSROOM MANAGEMENT

- a) Preparing for effective Classroom management
- b) Preventive Classroom management- Establishing Rules and Procedures, Teaching Rules and Procedures.
- c) Techniques of Classroom management

- d) Preventing and Managing Deviant Behaviour
- e) Assertive Discipline
- f) Working towards Self-management
- g) Time and Space Management (utilise time and manage workload efficiently)

References

- 16) Arends, Richard. (1998) *learning to Teach* (4th Ed), New Delhi, Mc Graw Hill.
- 17) Biehler and Snowman. (7th ed) (1993) *Psychology Applied to Teaching*. Boston: Houghton Mifflin Company
- 18) Classroom Management Strategies: Gaining and Maintaining Students Cooperation - James S
- 19) Rethinking Classroom Management: Strategies for Prevention, Intervention, and Problem Solving - Patricia Sequeira Belvel , Maya Marcia Jordan
- 20) Ultimate Classroom Control Handbook: A Veteran Teachers On-The-Spot Techniques for Solving Adolescent Student Misbehavior - Dave Foley

SKILL COURSE IV: MEDIA LITERACY

- a) Media Literacy
 - i. The meaning, need, functions and relevance of Media Literacy.
 - ii. Examining how media messages are constructed.
 - iii. Identifying ideological messages embedded within all media.
 - iv. Identifying the negative messages communicated through the media.
 - v. Deconstructing media texts using the 'Media Triangle' (Eddie Dick)
 - vi. Identifying the 'story' *not being told* in various media.
- b) Objectification
 - i. Meaning of 'Objectification', gender stereotypes and roles.
 - ii. Critically analysing Media Advertisements for examples of objectification.
- c) Critical Thinking
 - i. Meaning need and function of critical thinking.
 - ii. Characteristics of critical thinkers.
 - iii. Critically analysing various media for bias, prejudice, misinformation and/or disinformation.
- d) Applying Media Literacy
 - i. Creating 'media messages' of different kinds (text, audio, and video).
 - ii. Expressing dissent by writing 'letters to the editor', writing articles or presenting street-plays.

References

- **Objectification Theory**, Psychology of Women Quarterly, 21 (1997), 173-206.
- **Sexual Objectification of Women: Advances to Theory and Research**. (2011). Dawn M. Szymanski, Lauren B. Moffitt, and Erika R. Carr. The Counseling Psychologist. 39(1) 6– 38.
- **Media and Information Literacy –Curriculum for Teachers**. (2011). Wilson, Carolyn, Alton Grizzle, Ramon Tuazon, Kwame Akyempong and Chi-Kim Cheung. Published by UNESCO. Paris, France.
- **Media Literacy and New Humanism**. (2010). José Manuel Pérez Tornero and TapioVaris. Published by the UNESCO Institute for Information Technologies in Education.
- **Media Literacy Project** (1993).
- Packard, Vance. **Hidden Persuaders**.
- Paul, Richard. **Thirty-Five Dimensions of Critical Thinking**.
- Langrehr, John. (1995). **Become a Better Thinker**. Wright Books Pvt. Ltd.: Victoria
- **The Miniature Guide to Critical Thinking – Concepts & Tools**.
[Available at: <http://www.d.umn.edu/~jetterso/documents/CriticalThinking.pdf>]
- **Handbook of Critical Thinking Resources**. Prince George Community College. (2004).
[Available at: <http://academic.pg.cc.md.us/~wpeirce/MCCCTR/handbook.pdf>]

SKILL COURSE V: (A) EVENT MANAGEMENT

- a) Introduction to Event planning and management,
- b) Event Production, Role of event planner
- c) Skills of good event organiser
- d) Importance of organizing events and its components,
- e) Techniques, Selections, Coordination, Creativity, Designing, Sponsorships,
- f) Event Gadget Management
- g) Public Relations
- h) Evaluation of organising an Event.

REFERENCES:

1. Event Planning by Jude Allen
2. Event Management by Lynn Van Der Wagen and Brenda Carlos
3. The Art of Successful Event Management by Tanaz Basrur
4. Successful Event Management – A Practical Handbook by Anton Shone & Bryn Parry 2nd Edition

5. Event Coordination by National Institution of Event Management (NIEM)

SKILL COURSEV (B):DISASTER MANAGEMENT

This Course focuses on Natural disasters, Preparedness, Response, First Aid and Fire Fighting.

- a) Terminology: Disaster, Hazard, Vulnerability, Risk
 - a. Meaning, differences and classifications
 - b) Disaster Risk Management and Disaster Preparedness & Response
 - a. Meaning of DRM and Disaster Risk Reduction
 - c) Natural Hazards
 - i. Types, causes, effects (Earthquakes, Tsunami, Cyclone, Flood, Drought, landslide)
 - ii. Mitigation Measures of each of the six hazards
 - d) Policy Documents related to Disaster Management
(Disaster Management Act, 2005; National Disaster Management Framework, 2011; National Policy on Disaster Management, 2009; National Disaster Management Guidelines, 2007)
 - i. Objectives
 - ii. Agencies – National and State
 - e) Identifying the role that the individual can play in Disaster Management at the grassroots level.
 - i. First Aid and Fire Fighting *
- *(These courses will be conducted by professional agencies set up for the same)

References:

1. Alexander, D.(1993) Natural Disasters, ULC press Ltd, London.
2. Carter, W. N.(1991) Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok.
3. Disaster Management in India, Ministry of Home Affairs, Government of India, New Delhi, 2011.
4. National Policy on Disaster Management, NDMA, New Delhi, 2009.
5. Disaster Management Act. (2005), Ministry of Home Affairs, Government of India, New Delhi.
6. District Disaster Management Plan-Model Template, NIDM, New Delhi, 2005.
7. A Global Report - Reducing Disaster Risk, A Challenge for Development; UNDP Publication, 2004.
8. Good practices in community based disaster risk management; Gol-UNDP Disaster Risk Management Programme; 2002 – 09.
9. Chakrabarty, U. K. Industrial Disaster Management and Emergency Response, Asian Books Pvt. Ltd., New Delhi 2007.

10. Parasuraman, S & Unnikrishnan, P. V. (ed.), India Disasters Report Towards a policy initiative. Oxford, 2000.

11. Valdiya, K. S., Environmental geology Indian context. Tata McGraw Hills, 1987.

Documents

- **National Disaster Management Framework.**(2011).Government of India. Ministry of Home Affairs. New Delhi.
- **National Policy on Disaster Management.**(2009). NDMA, Government of India. New Delhi.
- **National Disaster Management Guidelines – Preparation of State Disaster Management Plans** National Disaster Management Authority, Government of India. (July, 2007).
- **Disaster Management Act.** (2005). Ministry of Home Affairs, Government of India, New Delhi, 2005.

BSBAEDUM 07-08 PEDAGOGY OF PHYSICAL SCIENCE I

Objectives :

On completion of the course, the student teacher will be able to :

- gain an understanding of the nature of knowledge in Physical Science and its validity.
- gain an understanding of the structure of physical science.
- review the contributions of Physicists and Chemists to the knowledge domain of Physical Science.
- integrate knowledge in Physical Science with other school subjects.
- trace the changing trends in learning of Physical Science with respect to its goals and approaches to learning.
- analyse the content in Physical Science with respect to its categories, process skills, knowledge organization and other critical issues.
- develop concept maps representing units, themes and inter relatedness among concepts.
- develop process oriented objectives based on content themes/ units.
- identify alternative conceptions held by students and teachers in general.
- Examine the content to understand that different themes require differential treatment.
- Examine the different ways in which learning situations can be created to learn concepts in Physical Science.
- Formulate meaningful inquiry episodes, problem solving situations, investigatory projects based on secondary school science.
- Examine different pedagogical issues in the content of learning Physical Science.

Transaction Mode:

Short lectures, organizing inquiry activities/ open-ended activities for learning Physical

Science, Group work on analysis of content in selected topics in Physical Science at the secondary level from both State and CBSE textbooks. Reading biographies of Physicists and Chemists, articles on gender issues, social and ethical issues, inclusiveness and their presentation in the classroom. Use of CDs related to Physical Science at the secondary level.

COURSE CONTENT :

Unit I: The nature and scope of knowledge in Physical Science

What is Science? Nature of Science. Development of scientific knowledge – observation, experimentation, classification.

Concepts, facts, theories and generalizations.

Historical status of Physical science concepts and theories.

Contributions of Indian and International Physicists and chemists to the knowledge domain of Physical Science with special reference to the methods of discovery/ investigation adopted.

The place of physical science in the school science curriculum.

Integration of knowledge in Physical Sciences with the other school subjects.

Application of Physical science knowledge in daily life.

Unit II : The Changing emphasis in learning of Physical Science

The changing trends in the goals and objectives of learning of Physical science in 21st century.

Development of process skills (Observation, classification, interpretation, control of variables, measuring, experimenting, hypothesizing, inferring, predicting and communicating).

Stating objectives in terms of learning process. Metacognitive thinking and learning of physical science. Learner as a constructor of knowledge

Alternative conceptualizations (misconceptions) of students and teachers in Physical Science (some examples).

Unit III : Approaches to constructing knowledge in Physical Science

Approaches to concept learning, conceptual change model (reconstructing ideas about certain Physical science concepts).

Different types of inquiry methods; problem solving strategies; investigatory approach; guided discovery approach; inductive method; learning through projects. Concept mapping as a tool of learning.

Cooperative and collaborative learning; group investigation;

Use of analogies in evolving the meaning of a Physical science concept.

Unit IV : Focus pedagogical issues

Role of Language in Science

Science, society and technology their influence on school curriculum.

Science related social and ethical issues-Inclusiveness in learning.

Learning beyond Textbooks- Self learning strategies. Multi Media; interactive learning

approach

Units for Pedagogic Analysis

Light : Rectilinear propagation of light, Reflection and refraction of light, image formation in lenses and mirrors, optical instruments, dispersion of light, rainbow formation (primary and secondary), nature of light, electromagnetic spectrum.

Gravitation : Universal law of gravitation, acceleration due to gravity 'g' as intensity of the gravitational field, escape velocity, weightlessness in space, Kepler's Laws of planetary motion and its applications.

Electronic Configuration : Electronic configuration of atoms, atomic properties and periodic classification of elements.
Any other unit chosen by the teacher.

Sessional Activities:

- Content analysis of units and statement of objectives in terms of process skills.
- Presentation of contributions of Physicists and Chemists to Physical Science.
- Planning learning experiences to develop different skills and their presentation.
- Identification of students and teachers, alternate conceptions in Physical Science and methods to re-conceptualise them.
- Concept mapping in selected units in Physical Science Planning learning situations for constructing knowledge in Physical Science.
- Group Discussion on pedagogical issues.
- Development of PowerPoint presentations in selected units in Physical Science.

References:

1. National Curriculum Framework 2005, NCERT, New Delhi.
2. Steve Alsop, Keith Hicks (2007). Teaching Science : A Handbook for Primary and Secondary School Teachers, Kogan Page, New Delhi.
3. Judith Bennett (2003) Teaching and Learning Science : A guide to recent research and its applications, Continuum, London.
4. Robin Millar (1984) Doing Science : Images of Science in Science Education, The Falmer Press, London.
5. NCERT Textbook in Physics for XI and XII Students.
6. State Textbook in Physics for XI and XII students.
7. Nathan S Washton (1967). Teaching Science Creatively, Saunders Company, London.
8. History of Physics in the 20th Century, Internet Browsing.
9. Novak D J and D Bob Gowin (1984) Learning how to learn, Press Syndicate of the University of Cambridge, Ohio.
10. Carin A and B R Sund (1964), Teaching Science through Discovery, Charles E. Merrill Books Inc., Columbus Ohio.
11. Ralph Martin, Colleen Sexton, Kay Wagner, Jack Gerlovich (2000) Science for All

- Children : Methods for Constructing Understanding, Allyn and Bacon, London.
12. School Science Review, The Association for School Education, College Lane, Hatfield, Hertfordshire, AL 109 AA, UK.
 13. Physics Education, Institute of Physics Publishing, Dirac House, Temple Block, Bristol BS1 6BE, UK.
 14. Physics Teacher, American Association of Physics Teachers, Department of Physics and Astronomy, University of Maryland, College Park, MO 20742.

BSBAEDUM 07-08 PEDAGOGY OF MATHEMATICS I

Objectives:

On completion of the course the students will have

- Understanding of the characteristics of Mathematical language and its role in Science
- Understanding of the nature of axiomatic method and mathematical proof.
- Knowledge about aims and general objectives of teaching secondary school mathematics.
- Ability to state specific objectives in behavioural terms with reference to concepts and generalizations.
- Ability to teach different kinds of mathematical knowledge consistent with the logic of the subject
- Ability to evaluate learning of concepts and generalization
- Ability to identify difficulties in learning concepts and generalization and provide suitable remedial instruction.

(All transactions to be made based on the appropriate contents listed in Unit 5).

COURSE CONTENT:

Unit I: Nature and Scope of Mathematics

Meaning and dimensions of mathematics, the nature of mathematical propositions; truth values, compound propositions; truth tables; open sentences; truth sets; Venn diagram; logically valid conclusions; use of quantifiers. Implications - one way and two way - necessary and sufficient conditions; A mathematical theorem and its variants - converse, inverse and contra positive, undefined terms in mathematics; quasi definitions and definitions in mathematics; the defining properties of a

definition; Difference between proof and verification; Difference between pure and applied mathematics; History of mathematics with special emphasis on Indian mathematics.

Unit II : Aims and Objectives of Teaching Secondary School Mathematics and Planning for Instruction

Need for establishing general objectives for teaching mathematics, Study of the aims and general objectives of teaching mathematics vis-à-vis the objectives of secondary education. Writing specific objectives of different content categories in mathematics. Selecting the content for instruction, identifying teaching points for a mathematics lesson; organization of

content.

Stating instructional objectives for a mathematics lesson and identifying learning outcomes in behavioural terms.

Designing – learning experiences; appropriate strategies; teaching aids; evaluation tools, etc.

Writing lesson plans for mathematics lessons.

Planning a unit of instruction in mathematics.

Unit III : Strategies for Learning Mathematical Concepts

Nature of concepts, concept formation and concept assimilation, Moves in teaching a concept - defining, stating necessary and/or sufficient condition, giving examples accompanied by a reason. Comparing and contrasting; giving counter examples; non examples; Use of Concept Attainment and Advance Organizer Models, planning and implementation of strategies in teaching a concept.

Unit IV : Teaching of Generalisation

By exposition: Teaching by exposition, Moves in teaching a generalization; introduction, Introduction moves - focus move, objective move, motivation move - Assertion move, application move, interpretation moves, justification moves - planning of expository strategies of teaching generalizations.

By guided discovery: Nature and purpose of learning by discovery, Inductive, deductive - guided discovery strategies, Maxims for planning and conducting discovery strategies; planning of strategies involving either induction or deduction or both.

Sessional Work:

1. Analysis of a unit/chapter in a mathematics textbook to identify the concepts, principles and processes and to understand the underlying mathematical structures.
2. Stating specific objectives for a mathematics lesson.
3. Identification and evaluation of moves and teaching skills used in a lesson/lesson plan.
4. Planning and implementation of appropriate strategies for teaching mathematical concepts and generalizations in simulated and real classroom situations.
5. Construction of appropriate test items to measure different outcomes of learning concepts and generalization.
6. Identification of students' learning difficulties and their remediation.

References:

1. Butler and Wren (1965). , The Teaching of Secondary Mathematics, London: McGraw Hill Book Company.
2. Cooney, T.J. and Others (1975), Dynamics of Teaching Secondary School Mathematics, Boston: Houghton Mifflin.
3. Kapfer, Miriam B (1972). Behavioural objectives in Curriculum Development: Selected Readings and Bibliography. Englewood Cliffs, NJ: Educational Technology.
4. Mager, Robert (1962). Preparing instructional objectives, Palo Alto, C A: Fearon.
5. NCERT, A textbook of Content-cum-Methodology of Teaching Mathematics, New Delhi: NCERT.

6. Polya, George (1957) How to solve it, Garden City, New York: Doubleday.
7. Servas, w and T. Varga. Teaching School Mathematics - UNESCO Source Book.
8. State text books in Mathematics of Southern Region from Class VI to X.

Periodicals

Journal of Research in Mathematics
 Mathematics Teaching
 School Science and Mathematics
 The Mathematics Teacher

BSBAEDUM 07-08 PEDAGOGY OF BIOLOGICAL SCIENCE I

Course Objectives:

The student teachers will be able to

- understanding of the nature of knowledge and its validity in Biological Science.
- review the contributions of Biologists to the knowledge domain of Biological Science.
- trace the changing trends in learning of Biology with respect to its goals, and approaches to learning.
- analyze the biological content with respect to its content categories, process skills, knowledge organization and other critical issues.
- develop concept maps representing units, themes and interrelatedness among concepts.
- develop process-oriented objectives based on the content themes/ units.
- identify the biological concepts that are alternatively conceptualized by teachers and students in general.
- examine the content to seek an understanding that different themes require differential treatment.
- explore the different ways of creating learning situations in learning of biological concepts and plans accordingly.
- formulate meaningful inquiry episodes, problem solving situations, investigatory projects based on secondary school biology.

Transaction Mode : Short Lectures wherever necessary; Use of inquiry episodes related to approaches to teaching of biology; Group work followed by Presentations ; Use of Films to raise issues and discussions related to conserving animals and plants : Use of audio tapes on Scientific attitude to generate inquiries related to certain myths and superstitions followed by group work and analysis and presentations; Demonstrations of different approaches with examples from biology units at secondary level; Use of NCERT and state text books ; Reading of articles based on social and ethical issues , gender issues related to science followed by presentations. School visits to observe Biology lessons and write observations.

COURSE CONTENT :

Unit I: Foundations of Biological sciences

A. Nature and scope of knowledge in Biological Science

- Meaning and branches of biological science and their relevance to knowledge and technological domains
- Nature of knowledge in Biological Science- empirical, experiential, knowledge categories: Biological concepts, facts, principles, generalizations and theories.
- Historical evolution of biological concepts and theories with special emphasis to those included in the school curriculum; Ancient Indian views on classification and existence of life forms and evolution of life,
- Contributions of Indian and International Biologists to the knowledge domain of biological science with special reference to the methods of discovery/ investigation adopted.
- Application of the knowledge of biology for human welfare. B.

Learning of Biological science

- Implications of different perspectives of learning by Piaget, Bruner, Ausubel Vygotsky and Suchman to teaching and learning of Biology
- Constructivist's approach to learning of Biology
- Metacognitive thinking and learning of biology

Unit II : The Changing emphasis in learning biology

- The changing trends in the goals and objectives of learning Biology (with reference to national and international Biology curriculum at school level)
- Development of process skills (Observation, classification, interpretation, control of variables, measuring, experimenting, hypothesizing, inferring, predicting and communicating) through learning Biology
- Need for stating objectives; relating subject/unit specific objectives to the main science curriculum goals; classification of objectives-cognitive (revised taxonomy); affective and psycho motor; use of action verbs
- Stating objectives based on revised taxonomy of objectives; standard based biology curriculum
- Development of scientific attitude and environmental values through the processes of learning Biology.

Environment as a rich learning site to construct meanings and concepts related to Biology through observational and exploratory activities.

Unit III: Strategies for teaching Biological science

- Approaches to concept learning: concept learning and attainment models;
- Alternative conceptualizations (misconceptions) of students and teachers in Biology conceptual change model (reconstructing ideas about certain biological concepts);

- Approaches to learning of generalizations: Expository; inductive approach
- Learning by Inquiry: Different types of inquiry methods;
- Learning by Discovery: experimental, field observations; guided discovery approach
- Problem solving strategies; investigatory approach; group investigation
- Learning through projects: Different types of projects in biology
- Constructivist learning designs (any 3)
- Use of Multi Media and interactive learning approaches in learning of Biology.
- Cooperative and collaborative learning strategies and their use in constructing knowledge,
- Use of different approaches to develop scientific attitude and environmental attitude and important values through Biology (examples – conserving environment, ,care for animals, cleanliness of surroundings , removal of certain social taboos related to diseases, reproduction, health etc.)

Unit IV: Pedagogical analysis for teaching Biological science

- **Content analysis :** Identification of units, themes, concepts, generalizations, problems or issues, knowledge organization in CBSE and State textbooks of VIII, IX and X Standards; identification of concepts and teaching points, themes or issues through which scientific attitude or important values can be developed. (structure of plant and animal cell, tissues, life processes, Diversity of living organisms, conservation of Biodiversity, why we fall sick? Crop improvement, Control and Co-ordination, How do organisms reproduce?, Our Environment , Heredity and Evolution)
- Different types of concepts – examples from Biology units; concept analysis;
- Concept mapping of the lesson/unit/theme to be taught
- Writing learning objectives on the selected lesson/unit

Sessional Work :

- Content analysis of Biology units, concept mapping , and writing of learning objectives
- Assignment on Contribution of Biologists (Indian and Western) to the knowledge domain of Biology
- Identification of Process skills on the selected Biology units
- Exploration of alternative conceptions held commonly by students and planning of approaches towards reconceptualizations – Project
- Assignment on writing lessons using different strategies of teaching

References:

1. Devereux,Jane (2000): Primary Science – Developing subject knowledge, Sage publications Inc, London.
2. Esler, K. William & Mark. K.Esler (2001): Teaching Elementary Science (8th edition) Wadsworth group, Thomas learning, Printed in the USA.
3. Heiss, E.D.Obourn E.S and Hoffmann C W (1961): Modern Science teaching by Macmillan publication, New York.
4. Jakab, Cheryl (1990): Exploring together (Revised Edition) – A science course for Primary schools, Phoenix Education Private Limited.

5. Jennings T (1986): The young scientist investigates- Teacher's Book of Practical work, Oxford University Press, Oxford.
6. Judith Beunet (2003): Teaching and Learning Science – A guide to recent research and its applications
7. Keith skamp (ed) (2004): Teaching primary science constructively -2nd edition, Thomson, by Nelson Australia Private Ltd.
8. Mason M & Ruth T. Peters: Teacher guide for Life sciences, Published by D. Van Nostrand Company, Inc, New york.
9. NCERT text books (2005) science for classes from VIII to X
10. New UNESCO Source Book for teaching science, UNESCO, Paris, Richardson, J.S. Science teaching in secondary schools; New york; prentice hall.
11. Novak. D.J & D.Bob Gowin (1984): Learning how to Learn,published by the press syndicate of the University of Cambridge, Printed in the USA.
12. Robin Millan (1984): Doing Science: Images of Science in Science education, the Falmer Press, London.
13. Saunders, N.H. (1962) The teaching of General science in Tropical secondary schools; London; Oxford University press.
14. State text Books for classes VIII to X.
15. Steve Alsop, Keith Hicks (2007): Teaching Science: A Handbook for Primary and Secondary school teachers, Kogan Page, N.Delhi
16. Synik, K.M: Living in the Environment – A source book for Environment al Education, UNESCO.
17. Turner,T & W.Dimarco (1988); learning to teach science in the secondary school – a companion to school experience, Published by Routledge, USA.

BSBAEDUM 07-08

PEDAGOGY OF PHYSICAL SCIENCE II

Course Objectives :

On completion of the course, the student teachers will be able to

- plan learning designs based on problem situations, inquiry and projects to facilitate learning of Physical Sciences.
- realise his/her role as a facilitator in enhancing Physical Science learning in the real classroom situation.
- explore the use and relevance of different learning resources and materials in learning different units in Physical Science.
- develop learning materials on selecting units to facilitate learning in Physical Science.
- identify themes in Physical Science for which community can be used as a learning resource.
- conduct Physical Science related activities through science clubs, science fairs, science exhibitions during school attachment.
- study science laboratory in schools, facilities and materials available in class that facilitate learning of Physical Science.
- familiarize with different types of curricular projects in physical science, their

purpose and themes.

- become aware of various professional organizations and professional development programs in Physical Science.
- reflect upon his/her own experiential knowledge in the different processes of becoming a Physical Science teacher.

Transaction Mode:

Lectures when required, group work on pedagogic analysis of content, concept mapping and planning learning designs, group work followed by presentation, discussion on different methods of grouping and execution of the learning designs to help students to construct knowledge, perform exemplar laboratory activities, prepare science kits and exemplar materials, improvise apparatus, visit science laboratories, schools for observing lessons, science museum, science park.

COURSE CONTENT:

Unit I : Pedagogic planning in learning Physical Science

Visualising learning situations

Content analysis – writing process objectives.

Planning lessons (integrating the processes: engage, explore, explain, elaborate and evaluate).

Different ways of grouping learners for collaborative learning, creating learning situations.

Teachers' Role as a facilitator

Providing multiple learning contexts and opportunities, encouraging student ownership of knowledge and engagement in the learning process, effective ways of questioning, engaging in learning episodes, helping learners to develop the attitudes of the rational problem solver, taking account of students' prior knowledge – encouraging students' inquiry abilities, valuing students' ideas and small group work, different ways of scaffolding and negotiating.

Unit II : Learning Resources and Preparation of Materials

PSSC curriculum projects; Nuffield Physics (O Level); Nuffield Chemistry; Harvard Project Physics; ChemStudy. National Curriculum Frameworks – NCERT – proposed themes and integrated nature for Physical Science at secondary level. Journals -School Science Review, School Science(NCERT)

Preparation and use of learning aids contextually. Audio-visual materials – charts, models , science kits, etc.

Visits to Museum, Science Park and community as a resource site for learning physics. Self-learning materials – worksheets.

Websites on physical science content, interactive websites, online learning

Planning of science labs – facilities, equipments, materials and manuals, records maintenance and management of science labs.

Unit III : Assessment of Learning in Physical Science

Construction of test items (unit test) to assess simple factual knowledge, higher thinking and application abilities; use of observation techniques, Student-Teacher Profile, recording and evaluating procedures to assess the performance of students' activities, projects, laboratory skills; group assessment; self and peer assessment; assessment of worksheets; students'

journals; use of rubrics in assessment. Portfolio assessment. Teacher's reflections in the process.

Unit IV : Professional Development of Physical Science Teachers

Professional competencies of Physical science teachers.

Need for updating content and pedagogical science competencies;

Participation in planning of science fairs, exhibitions and activities, planning contextual activities (celebration of Science Day, birthdays of great physicists and chemists), seminars, conferences, online sharing, distance learning, membership of Professional Organisations – NSTA, IPA, IAPT, Indian Chemical Society, INSC, Action Research, NCERT and VP activities for Teachers, NCERT journals, Publications in Science Education journals.

Units for Pedagogic Analysis

Heat : Heat as molecular motion, concept of heat and temperature, specific heat, latent heat, change of state, transfer of heat, thermal expansion.

Current Electricity : Concept of electric current, Ohm's law, Resistances in series and parallel, effects of electric current, magnetic effects, Oersted's experiment, electromagnetic induction.

Dalton's atomic Theory : Laws of chemical combination – atomic weight – molecular weight and mole concept.

Chemical Bonding : Why and how atoms combine – covalent bond, electrovalent bond, shapes and polarities of molecules.

Any other unit chosen by the teacher.

References:

1. National Curriculum Framework 2005, NCERT, New Delhi.
2. Steve Alsop, Keith Hicks (2007). Teaching Science : A Handbook for Primary and Secondary School Teachers, Kogan Page, New Delhi.
3. Judith Bennett (2003) Teaching and Learning Science : A guide to recent research and its applications, Continuum, London.
4. Robin Millar (1984) Doing Science : Images of Science in Science Education, The Falmer Press, London.
5. NCERT Textbook in Physics for XI and XII Students.
6. State Textbook in Physics for XI and XII students.
7. Nathan S Washton (1967). Teaching Science Creatively, Saunders Company, London.
8. Novak D J and D Bob Gowin (1984) Learning how to learn, Press Syndicate of the University of Cambridge, Ohio.
9. Carin A and B R Sund (1964), Teaching Science through Discovery, Charles E. Merrill Books Inc., Columbus Ohio.
10. Ralph Martin, Colleen Sexton, Kay Wagner, Jack Gerlovich (2000) Science for All Children : Methods for Constructing Understanding, Allyn and Bacon, London.
11. School Science Review, The Association for School Education, College Lane, Hatfield, Hertfordshire, AL 109 AA, UK.
12. Physics Education, Institute of Physics Publishing, Dirac House, Temple Block,

Bristol BS1 6BE, UK.

13. Physics Teacher, American Association of Physics Teachers, Department of Physics and Astronomy, University of Maryland, College Park, MO 20742.

BSBAEDUM 07-08

PEDAGOGY OF MATHEMATICS II

Objectives:

On completion of the course the student will have

- Understanding of mathematical proof in the context of secondary school mathematics
- Understanding of nature, importance and strategies of problem-solving
- Ability to teach proof of theorem and solution of problem to develop relevant skills.
- Ability to evaluate understanding of proof of a theorem and problem-solving skills.

COURSE CONTENT:

Unit I : Teaching of Proof

Proof: Developing an intuition about the nature of proof - to make the transition from concrete thinking to more formal reasoning and abstract thinking as they progress from class to class, kinds of proof - proof by mathematical induction, proof by contradiction, proof by cases, the contrapositive, conjectures, disproof by counter example.

Unit II : Teaching of Problem Solving

Definition of a problem, problem solving and teaching problem solving; importance of teaching problem solving posing a problem, discovering or exploring various options for solving the problem i.e. developing heuristics, carrying out the plan and generating and extending a good problem.

Unit III: Evaluation of Learning in Mathematics

Stating measurable objectives of teaching concepts and generalizations, construction of appropriate test items, Diagnosing basic causes for difficulties in learning concepts and generalizations, planning remedial instruction based on the diagnosis.

Unit IV : Learning Resource in Mathematics

Meaning, Types and purposes of instructional materials in Mathematics, Plan for preparation and utilization of instructional materials. Preparation of instructional materials. Designing teaching aids in mathematics; psychological basis; Rationale and limitations.

Pedagogical Analysis of Secondary School Mathematics

In order to explain the different pedagogical aspects of teaching mathematics, the following topics in mathematics which are presently taught at secondary school level are included. (As and when there are changes in topics to be taught in Mathematics at school level, the corresponding changes in topics should be made).

Arithmetic:

Development of number system; Modular Arithmetic, Ratio and proportion, time and work.

Algebra:

Sets, Relations, Functions and Graphs, Systems of linear equations and their graphical solutions, quadratic equations, Linear inequations and graphical solutions and their applications, Theory of Indices and logarithms, Cyclic factorization, Factor theorem and Remainder Theorem, Matrices, Axioms of Groups and Fields with examples from Number Systems.

Geometry :

Axioms of Euclidian Geometry, Polygons and Circles, Congruency and similarity of triangles, Polyhedrons and Prisms, Introduction to transformation geometry of two dimensions (straight lines only), Construction of geometrical figures.

Trigonometry:

Trigonometric ratios, simple identities and elementary problems on heights and distances, solution of simple trigonometric equation.

Statistics:

Tabular and Graphical representation of Data, Measures of Central Tendency and Variability.

Computing:

Computer devices, flow charts and algorithms.

Sessional Work:

Observation and analysis of strategies followed in teaching proof and problem-solving
Preparation of atleast one lesson plan in each of teaching proof, and problem solving and practice of the strategies in simulated situation/real classroom situations. Construction of unit test in mathematics.

Construction of a diagnostic test and an achievement test. Planning and Implementation of remedial instructional strategies.

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3. Iglewicz, Boris and Stoye, Judith (1973). An Introduction to Mathematical Reasoning, New York : The MacMillan Co.
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BSBAEDUM 07-08 PEDAGOGY OF BIOLOGICAL SCIENCE II

Course Objectives:

The teacher-learner will be able to

- plan learning designs(lessons) based on problem-situations, inquiry episodes and projects using 5Es' to facilitate learning of biology.
- explore the use and relevance of different learning resources and materials in learning different Biological concepts and themes..
- develop learning materials on selected units/themes that facilitate learning of biology in the classroom
- identify the biological themes for which community can be used as a learning site.
- organise Biology related activities through eco or science club during school attachment.
- study the science laboratories in schools – lay out, facilities, equipments, and materials, specimens, models, and other learning aids available that facilitate learning of Biology.
- familiarize with the different types of curricular projects in biology and their purposes ,themes, learning materials, resources etc
- become aware of various professional development programmes in biology.
- reflect upon his/her own experiential knowledge in the different processes of becoming a Biology teacher.
- develop biology projects using ICT.

Transaction Mode:

Short Lectures wherever necessary; Use of exemplary learning designs; workshops to do content analysis, concept mapping and planning of learning designs; Group work followed by Presentations ; Demonstrations of grouping and creating learning situations and executing learning designs; School visits to observe Biology lessons and write observations ; lab activities in Biology; Use of different text books, other curricular materials; science kits as exemplary material; Visit to a National park or some other ecological sites to get hands-on experience as a teacher in planning and organizing biological tours with an objective of observing the environment and develop investigatory skills.

COURSE CONTENT:

Unit I : Pedagogic planning in learning Biology

- Concept of and need for a lesson plan
- Content analysis ; concept mapping; writing Learning objectives.
- Planning of lessons using different approaches of learning Biology (already covered in 5th semester) **Examples of units:** structure of plant and animal cell, tissues, life processes, Diversity of living organisms, conservation of Biodiversity, Why we fall sick? Crop improvement, Control and Co-ordination, How do organisms reproduce?, Our Environment , Heridity and Evolution)
- Planning of multiple learning contexts and opportunities based on the concepts, themes, issues and problems related to Biology; creating learning scenarios and episodes to engage the learners; encouraging; planning effective ways of questioning, taking account of students' prior knowledge; plan for students' inquiry abilities in Biology; planning for small group work, different ways of scaffolding and negotiating in understanding of Biological knowledge.
- Role of teacher's reflections in the process of planning and transacting the lesson .
- Planning of a unit and its importance

Unit II : Learning Resources and Preparation of Materials

- Preparation and use of learning aids contextually.
- Audio-visual materials: charts, models, aquaria, terraria, school garden, museum, herbarium, supplementary books, handbooks, laboratory guides, science kits, etc.
- Field trips, National parks, study tours and community as a resource sites for learning biology.
- Self-learning materials , and planning of worksheets.
- Using ICT in learning biology, websites on biology, interactive websites, online learning, and preparation of projects on Biology units using ICT.
- Use of science labs – facilities, equipments, materials and manuals, science records.
- Planning of exhibitions on conservation of environment; saving the planet; learning aids in Biology; contextual activities (Environmental Day, Earth Day, Wild Life Week, etc). Planning of fairs, eco-clubs and activities.
- Environment and community as a rich learning site to construct meanings and concepts related to Biology through observational and exploratory activities.

Unit III : Curriculum reforms and Assessment in Biology learning

A. Curriculum reforms in Biology

- Exemplary prototype inquiry science programs (NSES), US; Project 2061 NSTS – SSC (Scope, Sequence and Coordination).
- BSCS curriculum projects
- Nuffield Biology curriculum projects
- National Curriculum Frameworks – NCERT – proposed themes and integrated nature for Biological science at secondary level.

- Critical appraisal of National and state level syllabi related to biology themes and units; Basic criteria of validity of a science curriculum; critical analysis of biology textbooks /biology content in the science textbooks and other curricular materials such as teachers handbook, source book and manuals

B. Assessment of and Assessment for learning Biology

- Periodic/continuous assessment: preparation and use of worksheets; use of observation techniques, recording and evaluating procedures to assess the performance of students' activities, projects, laboratory skills, drawing skills in biology; group assessment; self and peer assessment; assessment of worksheets; students' journals; use of rubrics in assessing students' performance based activities; feedback for improving learning; diagnosing learning difficulties in biology and planning for alternative learning strategies; Planning for Portfolio assessment in Biology
- Construction of different types of test items and questions to assess content specific-simple factual knowledge, higher order thinking and application abilities; preparation of blue print/table of specifications; Planning for a Unit test in Biology

Unit IV : Professional Development of Biology Teachers

- Professional competencies of Biology teachers.
- Need for updating content and pedagogical science competencies; participation in seminars, conferences, online sharing, distance learning, membership of Professional Organisations – NSTA, INSC, Action Research, Projects and Publications in Science Education journals.
- Role of reflection in professional development.

Sessional Activities:

- Planning of atleast 2 lessons and a unit plan on the Biology units /themes of VIII, IX, X classes
- Teaching Biology in real classroom /simulated situation .
- Preparation of learning aids and organizing an exhibition on the Annual Day of the Institution.
- Identifies the different community resources that can be used for learning Biology
- Analysis of Biology text books, and other curricular materials.
- Project work using ICT on any Biology lesson (using any one of the approaches – inquiry, investigatory etc.) and use it in the class during school attachment programme.
- School visits to study existing Lab facilities for learning Biology – Project
- Construction of assessment items and tools to assess content-specific tasks and demonstrations, observations, drawing skills, group discussions, Brain storming.
- Planning Performance tasks, Data recording sheets, Prediction activity sheets, and individual experiments and tools to assess embedded products and processes in activities..
- Reading of curriculum projects in groups and presentation
- Group work on professional competencies of Biology teachers
- Identification of Professional organizations for Biology teachers, Biology Journals and magazines

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