

CURRICULUM

In

CHEMISTRY

For

**UNDER GRADUATE COURSES (B.Sc.)
(Annual System)**

**PASSED BY THE BOARD OF STUDIES
IN CHEMISTRY**

(Applicable w.e.f. the session 2019-2020)



**Department of Chemistry
Rishikesh Campus**

**Sridev Suman Uttarakhand University Badshahithaul
Tehri-Garhwal - 249001**

Sri Dev Suman Uttarakhand University Badshshithaul Tehri Garhwal

Proposed Syllabus: Chemistry Course for B.Sc (Annual System)

B. Sc. Chemistry Syllabus

Objective of the course

To teach the fundamental concepts of chemistry and their applications, the syllabus pertaining to B.Sc(3 year degree course) in the subject of chemistry has been prepared as per provision of UGC module and demand of the academic environment. The syllabus concepts are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills. This B. Sc course of chemistry consists of three year course (annual system). Total marks: 600(200 per year).

B.Sc. First Year

Paper	Paper code	Course	Max. Marks	Work Hrs
I	CH-101	Inorganic Chemistry	50	60
II	CH-102	Organic Chemistry	50	60
III	CH-103	Physical Chemistry	50	60
	CH-104	Laboratory Practical	50	60
Grand Total			200	180

B.Sc. Second Year

Paper	Paper code	Course	Max. Marks	Work Hrs
I	CH-201	Inorganic Chemistry	50	60
II	CH-202	Organic Chemistry	50	60
III	CH-203	Physical Chemistry	50	60
	CH-204	Laboratory Practical	50	60
Grand Total			200	180

B.Sc. Third Year

Paper	Paper code	Course	Max. Marks	Work Hrs
I	CH-301	Inorganic Chemistry	50	60
II	CH-302	Organic Chemistry	50	60
III	CH-303	Physical Chemistry	50	60
	CH-304	Laboratory Practical	50	60
Grand Total			200	180

Note: Examiner should follow the below given pattern covering all the units for each section compulsorily:

- Twelve compulsory objective type questions of one mark each, $12 \times 1 = 12$ Marks
- Examinees to solve six short answer questions out of ten question (3 mark each) $3 \times 6 = 18$ Marks.
- Examinees to solve four long answer questions out of seven (5 mark each) $4 \times 5 = 20$ Marks

Distribution of marks for Practical exam will be as follows:

B.Sc. (FIRST YEAR)

(i)	Inorganic Mixture analysis (six radicals)	15
(ii)	Organic Experiment	12
(iii)	Physical Chemistry Experiment	10
(iv)	Viva-voce**	05
(v)	Annual record	08
	Total	50

B.Sc. (SECOND YEAR)

(i)	Inorganic Experiment	15
(ii)	Organic Experiment	12
(iii)	Physical Chemistry Experiment	10
(iv)	Viva-voce**	05
(v)	Annual record	08
	Total	50

B.Sc. (THIRD YEAR)

(i)	Inorganic Experiment	10
(ii)	Organic Experiment	12
(iii)	Physical Chemistry Experiment	15
(iv)	Viva-voce**	05
(v)	Annual record	08
	Total	50

*Full credit of marks shall be given upto 0.5% error after which for each 0.1% error, two marks shall be deducted in Quantitative analysis experiments.

**Viva-voce for ex-students shall carry 13 marks.

Three Years Degree Course Syllabus for
CHEMISTRY
B.Sc. (FIRST YEAR)

- Naphthalene 80-82°, Benzoic acid 121.5-122°, Urea 132.5-133°, Succinic acid 184.5-185°, Cinnamic acid 132.5-133°, Salicylic acid 157.5-158°, Acetanilide 113.5-114°, m-Dinitrobenzene 90°, p-Dichlorobenzene 52°, Aspirin 135°
- IV. Determination of boiling point:
Ethanol 78°, Cyclohexane 81.4°, Toluene 110.6°, Benzene 80°
Mixed melting point determination:
Urea-Cinnamic acid mixture of various compositions (1:4, 1:1, 4:1)
- V. Distillation:
Simple distillation of ethanol-water mixture using water condenser, Distillation of nitrobenzene and aniline using air condenser
- VI. Crystallization:
Concept of induction of crystallization, Phthalic acid from hot water (using fluted filter paper and steamless funnel) Acetanilide from boiling water, Naphthalene from ethanol, Benzoic acid from water
Decolorisation and crystallization using charcoal:
Decolorisation of brown sugar (sucrose) with animal charcoal using gravity filtration.
Crystallization and decolorisation of impure naphthalene (100g of naphthalene mixes with 0.3 g of Congo Red using 1g decolorizing carbon) from ethanol.
- VII. Sublimation (Simple and Vacuum): Camphor, Naphthalene, Phthalic acid and succinic acid.
Qualitative Analysis:
- VIII. Detection of extra elements (N, S and halogens) and functional groups (phenolic, carboxylic, carbonyl, esters, carbohydrates, amines, amides, nitro and anilide) in simple organic compounds.
Physical Chemistry:
- IX. Chemical Kinetics:
1. To determine the specific reaction rate of the hydrolysis of methyl acetate/ethyl acetate catalyzed by hydrogen ions at rooms temperature.
2. To study the effect of acid strength on the hydrolysis of an ester.
3. To compare the strengths of HCl and H₂SO₄ by studying the kinetics of hydrolysis of ethyl acetate.
4. To study kinetically the reaction rate of decomposition of iodide by H₂SO₄.
Distribution Law:
1. To study the distribution of iodine between water and CCl₄.
2. To study the distribution of benzoic acid between benzene and water.
- X. Viscosity, Surface Tension:
1. To determine the percentage composition of a given mixture (non interacting systems) by viscosity method.
2. To determine the viscosity of amyl alcohol in water at different concentration and calculate the excess viscosity of these solutions.
3. To determine the percentage composition of a given binary mixture by surface tension method (acetone & ethyl methyl ketone).

B.Sc. (SECOND YEAR)

There shall be three written papers and a practical examination as follows:

Paper	Paper code	Course	Max. Marks	Work Hrs
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SCHEME OF EXAMINATION

AND

COURSE OF STUDY

of

Mathematics

For

B.Sc. (PCM & PGM)

(w. e. f. Session 2019--2020)

(Yearly - System)



DEPARTMENT OF MATHEMATICS

**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI
GARHWAL, UTTARAKHAND**

B.A./B.Sc. I Year

S.N.	Paper	Paper code	Maximum Marks
1.	Differential Calculus	BM101	65
2.	Integral Calculus and Trigonometry	BM102	65
3	Algebra and Matrices	BM103	70

B.A./B.Sc. II Year

S.N.	Paper	Paper code	Maximum Marks
1.	Differential Equations	BM201	65
2.	Real Analysis	BM202	65
3	Advanced Algebra	BM203	70

B.A./B.Sc. III Year

S.N.	Paper	Paper code	Maximum Marks
1.	Linear Algebra & Linear programming Problems	BM301	65
2.	Complex Analysis	BM302	65
3	Numerical Analysis	BM303	70

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**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI
GARHWAL, UTTARAKHAND**

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: 1st

Subject Code: BM-101

Course Title: DIFFERENTIAL CALCULUS

Paper -I

Examination Duration: 2:30Hours

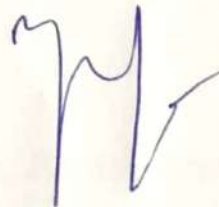
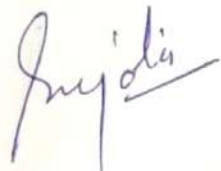
Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions. in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions. in which 5 to be answered, each of marks 6.

- I. Successive Differentiation, Leibnitz's theorem, Indeterminate form.
- II. Partial Differentiation, Euler's theorem, Homogeneous Functions, Jacobian.
- III. Tangents and Normal, Curvature, Asymptotes.
- IV. Singular Points, Maxima and Minima.
- V. Curve Tracing (Cartesian, Parametric, Polar).

Books Recommended:

1. M.Ray : Differential Calculus, Shiva Lal Agarwal and Co., Agra.
2. Gorakh Prasad :Differential Calculus, Pothishala publication, Allahabad



**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI
GARHWAL, UTTARAKHAND**

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: Ist

Subject Code: BM-102

Course Title: INTEGRAL CALCULUS & TRIGONOMETRY Paper -II

Examination Duration: 2:30Hours

Max. Marks: 65

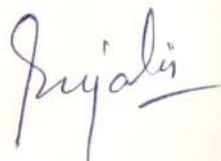
NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

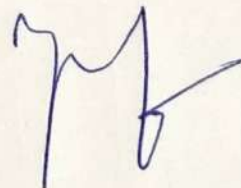
- I. Properties of Definite Integrals, Beta- Gamma functions.
- II. Rectification, Quadrature.
- III. Volumes and surfaces of solids of revolution, Double and triple integrals.
- IV. Separation into real and imaginary parts, Logarithmic of complex quantities, Hyperbolic functions with their inverses.
- V. Gregory's series, Summation of trigonometric series.

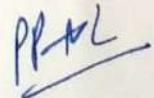
Books Recommended

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. H. Anton, I. Bivens and S. Davis, *Calculus*, John Wiley and Sons (Asia) P. Ltd., 2002.
3. S.L.Loney: *Plane Trigonometry (Part I, II)*, Arihant Publications.
4. M.D.Raisinghania, H.C.Sexena & H. K.Dass : *Trigonometry*, S. Chand & Company Pvt. Ltd. 2002.









**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI
GARHWAL, UTTARAKHAND**

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: Ist

Course Title: ALGEBRA AND MATRICES

Examination Duration: 2:30Hours

Subject Code: BM-103

Paper -III

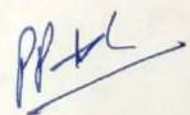
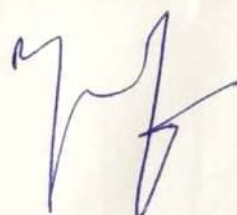
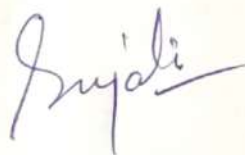
Max. Marks: 70

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 5. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

- I. Sets, Operations on sets, Relations, Equivalence relations and partition Functions, Algebraic structures, Group, Example of groups, Subgroups, Permutation group.
- II. Order of an element, Cyclic -group, Coset- decomposition, Lagrange's theorem and its consequences.
- III. Quotient group, Homomorphism, Isomorphism.
- IV. Rank of a matrix, Invariance of rank under elementary transformations, Adjoint of matrices, Inverse of matrices, Reduction to normal form.
- V. Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto four, Solutions of a system of linear equations using matrices. Eigen values, Eigen vectors and Characteristic equation, Cayley Hamilton theorem and its Applications.

Books Recommended

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. Joseph A Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
3. A.I. Kostrikin, Introduction to Algebra, Springer Verlag, 1984.
4. Richard Bronson, Theory and Problems of Matrix Operations, Tata McGraw Hill, 1989.



**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI
GARHWAL, UTTARAKHAND**

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: IInd

Course Title: DIFFERENTIAL EQUATIONS

Examination Duration: 2:30Hours

Subject Code: BM-201

Paper -I



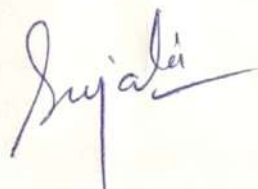
Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

- I. First order exact differential equations, Integrating factors, Rules to find an integrating factor, First order higher degree equations solvable for x , y , p , methods for solving higher-order differential equations.
- II. Basic theory of linear differential equations, Wronskian, and its properties, Solving a differential equation by reducing its order.
- III. Linear homogenous equations with constant coefficients, Linear non-homogenous equations, The method of variation of parameters.
- IV. The Cauchy-Euler equation. Simultaneous differential equations, Total differential equations.
- V. Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations. Linear partial differential equation of first order, Lagrange's method, Charpit's method.

Books Recommended:

1. MShepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
2. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition, 1967.



**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI
GARHWAL, UTTARAKHAND**

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: IInd

Course Title: REAL ANALYSIS

Examination Duration: 2:30Hours

Subject Code: BM-202

Paper -II

Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

- i. Finite and infinite sets, Examples of countable and uncountable sets, Real line, Bounded sets. Suprema and infima, Completeness property of \mathbb{R} . Archimedean property of \mathbb{R} , Intervals, Concept of cluster points and statement of Bolzano-Weierstrass theorem.
- ii. Real Sequence, Bounded sequence, Cauchy convergence criterion for sequences. Cauchy's theorem on limits, Order preservation and squeeze theorem. Monotone sequences and their convergence, Monotone convergence theorem without proof.
- iii. Infinite series, Cauchy convergence criterion for series, Positive term series, Geometric series, Comparison test. Convergence of p-series, Root test, Ratio test, Alternating series, Leibnitz's test (Tests of convergence without proof), Definition and examples of absolute and conditional convergence.
- iv. Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of $\sin x$, $\cos x$, e^x , $\log(1+x)$, $(1+x)^m$.
- v. Sequences and series of functions, Point wise and uniform convergence. Mn-test, M-test, Statements of the results about uniform convergence and integrability and differentiability of functions, Power series and radius of convergence.

Books Recommended

1. T. M. Apostol, *Calculus* (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons (Asia), P. Ltd., 2000.
3. K.A. Ross, *Elementary Analysis- The Theory of Calculus Series-* Undergraduate Texts in Mathematics, Springer Verlag, 2003.
4. Texts in Mathematics, Springer Verlag, 2003

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**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL, TEHRI
GARHWAL, UTTARAKHAND**

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: IInd

Course Title: ADVANCED ALGEBRA

Examination Duration: 2:30Hours

Subject Code: BM-203

Paper –III

Max. Marks: 70

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 5. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

- I. Cayley's theorem. Normalizer and center of a group.
- II. Normal subgroups and their properties, Simple group.
- III. Rings, various types of rings, Subrings, Properties of rings.
- IV. Ideals, Principal ideal ring. Quotient rings. Characteristics of a ring.
- V. Integral domain, Field, Skew field; Examples and its characterizations.

Books Recommended

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. Joseph A Gallian. Contemporary Abstract Algebra, 4th Ed., Narosa, 1999.
3. Khanna & Bhambhari, A course in Abstract Algebra, 4th ED, Vikash Publication 2006.

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**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL,
TEHRI GARHWAL, UTTARAKHAND**

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: IIIrd

Course Title: LINEAR ALGEBRA & LPP

Examination Duration: 2:30Hours

Subject Code: BM-301

Paper –I

Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

- i. Vector spaces, Subspaces, Algebra of subspaces, Quotient spaces, Linear combination of vectors, Linear span, Linear independence, Basis and dimension, Dimension of subspaces. Linear transformations, Null space, Range, Rank and nullity of a linear transformation, Matrix representation of a linear transformation, Algebra of linear transformations.
- ii. Dual Space, Dual basis, Double dual, Characteristic polynomial, Eigenvalues and eigen vectors, Isomorphisms, Isomorphism theorems, Invertibility and isomorphisms, Change of coordinate matrix.
- iii. Linear programming problems, Graphical approach for solving some LPP, Convex sets, Supporting and separating hyper planes.
- iv. Theory of simplex method, Optimality and unboundedness, The simplex algorithm, Simplex method in tableau format, Introduction to artificial variables.
- v. Two-phase method, Big-M method and their comparison. Duality, formulation of the dual problem, Primal-dual relationships, Economic interpretation of the dual.

Books Recommended

1. Stephen H.Friedberg, Arnold J.Insel, Lawrence E.Spence, *Linear Algebra*, 4thEd., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
2. David C.Lay, *Linear Algebra and its Applications*, 3rdEd., Pearson Education Asia, Indian Reprint, 2007.
3. S. Lang, *Introduction to Linear Algebra*, 2nd Ed., Springer, 2005
4. F.S.HillierandG.J.Lieberman, *Introduction to Operations Research*, 8thEd., TataMcGrawHill, Singapore, 2004.
5. Hamdy A. Taha, *Operations Research, An Introduction*, 8th Ed., Prentice-Hall India, 2006.

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**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL,
TEHRI GARHWAL, UTTARAKHAND**

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: IIIrd
Course Title: COMPLEX ANALYSIS
Examination Duration: 2:30Hours

Subject Code: BM-302
Paper –II
Max. Marks: 65

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 4. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

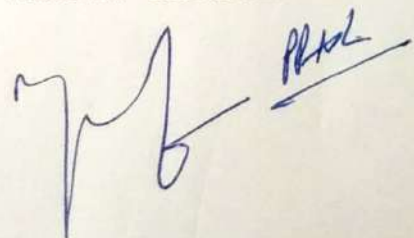
- I. Complex numbers and basic properties, Geometric representation of complex numbers, Trigonometrical and hyperbolic complex functions, Analytical, Cauchy-Riemann equations. Harmonic functions.
- II. Conformal Mapping: Geometric representations, transformations, Theorems on Conformal mapping, Magnification, The circle, Inverse point w.r.t. a circle, Some elementary Transformations, Bilinear Transformations, Some special Bilinear Transformations, Fixed point and Normal form of a Bilinear Transformations.
- III. Complex integration: Cauchy's Integral Theorem, Cauchy's fundamental theorem of integration, Cauchy's Integral formula, Cauchy's Integral formula for the derivative of Analytic functions, Morera's theorem.
- IV. Cauchy's Inequality, Taylor's theorem, Laurent's series, Liouville's theorem.
- V. Zeros and singularities of Analytic functions.

Recommended Books

1. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Ed., McGraw – Hill International Edition, 2009.
2. G C sharma & M. jain: *Complex Analysis*, Y.K. Publishers.
3. Mark J. Ablowitz & A. S. Fokas: *Complex Variables: Introduction & Applications* Cambridge Univ. Press.







**SRI DEV SUMAN UNIVERSITY, BADSHAHITHOL,
TEHRI GARHWAL, UTTARAKHAND**

NAME OF THE DEPARTMENT: MATHEMATICS

B.Sc. Semester: IIIrd

Course Title: NUMERICAL ANALYSIS

Examination Duration: 2:30Hours

Subject Code: BM-303

Paper –III

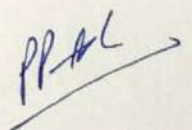
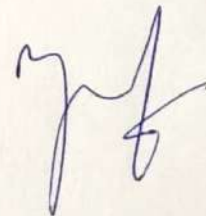

Max. Marks: 70

NOTE: The question paper consists of three sections A, B and C. Section A will consist 15 objective type questions (all compulsory), each of marks 1. Section B will consists of 10 short answered questions, in which 5 to be answered, each of marks 5. Section C will consist of 8 long answered questions, in which 5 to be answered, each of marks 6.

- i. Finite difference, Difference Operator, Factorial notation, Interpolation with equal Intervals.
- ii. Interpolation with unequal intervals, Divided difference, Central differences Stirling and Bessel formula (application only).
- iii. Numerical differentiation and Integration, Simpson's 1/3 and 3/8 rule, weddle's rule Trapezoidal rule and their accuracy.
- iv. Numerical solution of algebraic and transcendental equation, iterative bisection, Regula Falsi, Newton Raphson, Graeffe method.
- v. Numerical solution of differential equation, Picard's Euler, Modified Euler, Runge-Kutta Method.

Recommended Books

1. B. Bradie, *A Friendly Introduction to Numerical Analysis*, Pearson Education, India, 2007.
2. M.K.Jain, S.R.K. Iyengar and R.K.Jain, *Numerical Methods for Scientific and Engineering Computation*, 5th Ed., New age International Publisher, India, 2007.



**SRIDEV SUMAN UTTARAKHAND UNIVERSITY, BADSHAHITHAUL, TEHRI,
GARHWAL**

**SYLLABUS: BOTANY COURSE FOR B.Sc. STUDENTS (3 Years)
UNDER ANNUAL SYSTEM**

To teach the fundamental concept of Botany and their applications the syllabus pertaining to B.Sc (3 year degree course) in the subject of Botany has been prepared as per provision of UGC module and demand of academic environment. The syllabus concepts are duly arranged unit wise and contents are included in a such manner so that due importance is given to requisite intellectual and laboratory skills. This B.Sc course of Botany consists of 3 year course (Annual System). Total marks 600(200per year).

B.Sc Ist Year

S.NO.	TITLE	PAPER CODE	MAX. MARKS
I	Fungi, Elementary Microbiology and Plant Pathology	BBO-101	50
II	Algae and Bryophytes	BBO-102	50
III	Pteridophytes, Gymnosperm and Elementary Palaeobotany	BBO-103	50
	Lab Course	BBO-10P	50

B.Sc IInd Year

S.NO.	TITLE	PAPER CODE	MAX. MARKS
I	Taxonomy of Angiosperms and Economic Botany	BBO-201	50
II	Anatomy, Embryology and Elementary Morphogenesis	BBO-202	50
III	Ecology and Remote Sensing	BBO-203	50
	Lab Course	BBO-20P	50

B.Sc IIIrd Year

S.NO.	TITLE	PAPER CODE	MAX. MARKS
I	Cytogenetics, Molecular Biology and Biotechnology	BBO-301	50
II	Plant Physiology and Elementary Biochemistry	BBO-302	50
III	Plant Breeding and Biostatistics	BBO-303	50
	Lab Course	BBO-30P	50

Note : Examiner should follow the below given pattern covering all the unit for each section compulsory :

- Twelve Compulsory subject objective type questions of one mark each, $12 \times 1 = 12$.
- Examinees to solve 6 short answer questions out of 10 questions (3 marks each) $3 \times 6 = 18$ marks.
- Examinees to solve 4 long answer questions out of seven (5 marks each) $4 \times 5 = 20$ Marks.

B.Sc Ist Year

PAPER I: (BBO-101) FUNGI, ELEMENTARY MICROBIOLOGY AND PLANT PATHOLOGY

UNIT I

1. Brief history and salient features of Fungi.
2. A broad outline of classification of Fungi (Ainsworth) and salient features of the important groups.
3. Structure, methods of reproduction and life history of following Genera:
Synchytrium, Saprolegnia, Albugo, Rhizopus, Penicillium, Saccharomyces, Phyllactinia, Erysiphe, Puccinia, Ustilago, Agaricus and Alternaria.
4. Heterothallism, Parasexuality and Economic importance of Fungi.

UNIT II

1. Lichens: Habitats, characteristics, general structure and classification.
2. Physiology (Symbiotic relationship) and reproduction in Lichens.
3. Economic importance of Lichens.

UNIT III

1. General account of diversity of microorganisms.
2. Elementary principles of isolation and purification of microorganisms.
3. Role of microorganisms in carbon and nitrogen cycles in nature.

UNIT IV

1. Bacteria: Structure, classification, nutrition, reproduction, gram positive and gram negative bacteria; Economic importance of bacteria.
2. Viruses: Structure, transmission and multiplication. Economic importance of viruses. Brief idea of Bacteriophages.
3. General account of Mycoplasma.

UNIT V

1. General symptoms of plant diseases and principles of infection and resistance.
2. General methods of chemical and biological control of the plant diseases.
3. The symptoms, morphology of the causal organism, disease cycle and control measures of the following diseases : Wart disease of Potato, White rust of Crucifers, Powdery mildew of Shisham, Black rust of Wheat, Red rot of Sugarcane.

Suggested Readings

- Vashistha, B.R., Sinha, A.K. 2014. Botany for degree students: Fungi. S. Chand Publication, New Delhi
- Singh, V., Pandey, P.C. and Jain, D.K. 1998. A text book of Botany. Rastogi Publication Meerut
- Gangulee, H.C. and Kar, A.K. 1992. College Botany. Vol 2, Kolkatta
- Dubey, R.C. and Maheshwari, D.K. 2014. A text book of Microbiology. S. Chand Publication, New Delhi.
- Matthews, R.E. 2013. Fundamentals of Plant Virology, Elsevier India

PAPER II (BBO-102): ALGAE AND BRYOPHYTES

UNIT I

1. General characteristics of the group (Algae) and its position in Plant Kingdom.
2. Classification of algae, basic outlines of Fritsch's and Smith's classification.
3. Elementary knowledge of organisation of thallus in algae.

UNIT II

1. Structure, reproduction and life cycles of the following Genera:
Chlamydomonas, Volvox, Oedogonium, Vaucheria, Chara, Sargassum, Ectocarpus, Batrachospermum and Polysiphonia.
2. General account of Bacillariophyceae.
3. Cyanobacteria : General account of *Nostoc*.

UNIT III

1. Types of life cycles – Haplontic, Diplontic, Diplohaplontic, Haplodiplontic and Diplobiontic; Alternation of generation in Algae.
2. Ecology of Algae: Brief idea of freshwater and marine, terrestrial, epiphytic, parasitic, symbiotic algae and phytoplanktons.
3. Economic importance of algae as food, fodder, in agriculture, industry and public health.

UNIT IV

1. Outlines and basic principles of classification of the Bryophytes in accordance with the International Code of Botanical Nomenclature.
2. Comparative account of the gross morphology, anatomy, vegetative and sexual reproduction, development and structure of the sporophyte and mechanism of spore dispersal based on *Riccia and Marchantia*.
3. Habitat, distribution and economic importance of Bryophytes.

UNIT V

1. Comparative account of the gross morphology and anatomy of the gametophytes, vegetative and sexual reproduction, development and structure of the sporophyte and mechanism of spore dispersal in *Anthoceros* and Mosses (*Funaria*).
2. General account of Jungermanniales (*Porella*).
3. A brief account of the alternation of generation in Bryophytes.

Suggested readings

- Kumar, H.D. 1999. Introductory Phycology, Affiliated East West Press, New Delhi
- Vashistha, B.R., Sinha, A.K. and Singh, V.P. 2014. Botany for degree students: Algae. S. Chand Publication, New Delhi
- Vashistha, B.R., Sinha, A.K. and Kumar, Adarsh 2014. Botany for degree students: Bryophyta. S. Chand Publication, New Delhi
- Parihar, N.S. 1991. An Introduction to Bryophyta. Vol 1&2. Central Book Depot, Allahabad
- Puri, P.1980. Bryophytes. Atma Ram and Sons, New Delhi

PAPER III: (BBO-103) PTERIDOPHYTES, GYMNOSPERMS AND ELEMENTARY PALAEOBOTANY

UNIT I

1. General characters of the Pteridophytes and classification as proposed by Pichi-Sermolli.
2. A comparative study of *Rhynia*, *Selaginella*, *Lycopodium*, *Equisetum*, *Adiantum*, and *Marsilea* on the basis of following features:
3. Morphology and anatomy of the vegetative plant body and spore production organs (strobilus, sporocarp, sporophyll, sporangium and spores), sexual reproduction, male and female gametophytes, fertilization.

UNIT II

1. A brief account of Telome theory, Stellar system and its evolution.
2. Heterospory and seed habit in Pteridophytes.
3. Apogamy, agamospory and apospory in ferns.

UNIT III

1. Outlines of classification as proposed by D D Pant and distinguishing features of Gymnosperms.
2. Comparative account of the structure, life history and evolutionary trends based on the following Genera:
Cycas, *Pinus* and *Ephedra*
3. General anatomy- Types of wood thickening, tracheids, medullary rays, pitting and resin canals, mesarch and pseudomesarch, foliar bundles and types of stomata.

UNIT IV

1. Distribution of Gymnosperms in India.
2. Economic importance of the Gymnosperms.

UNIT V

1. Fossils: Types of fossils and process of fossilization.
2. A general idea about Geological era.
3. Living fossils.

Suggested Readings

- Parihar, N.S.1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad
- Vashistha, P.C., Sinha, A.K and Kumar, Anil 2012. Botany for degree students: Pteridophyta. S. Chand Publication, New Delhi
- Bhatnagar, S.P. and Moitra, A.1996, Gymnosperms, New Age International Pvt. Ltd, New Delhi
- Vashistha, P.C., Sinha, A.K and Kumar, Anil 2012. Botany for degree students: Gymnosperms. S. Chand Publication, New Delhi

Lab Course (BBO-10P)

Prepared slides and specimens should be shown to the students for demonstration of the general features. The students are required to make temporary slide preparation of the important plant material themselves. They are also required to submit a collection of plant species studied by them either on herbarium sheets or as specimen or live planted material as directed by the department.

FUNGI, ELEMENTARY MICROBIOLOGY & PLANT PATHOLOGY

1. To study identify and comment upon the following fungal materials by preparing the temporary slides/ specimens: *Saprolegnia*, *Albugo*, *Rhizopus*, *Saccharomyces*, *Phyllactinia*, *Morchella*, *Agaricus*, *Puccinia*, *Ustilago*, and *Alternaria*.
2. Study of morphology and structure of different types of lichens: Foliose, Fructicose, and Crustose.
3. Symptoms, morphology of pathogen and host parasite relationship of plant diseases: White rust of crucifers, Wart disease of potato, Loose smut of wheat, Black rust of wheat, Red rot of sugar cane and Powdery mildew of shisham
4. Different methods of isolation of microbes.
5. Staining of bacteria with gram stain.
6. Morphological features of viral infected plants; study of bacterial infections in plants.

ALGAE AND BRYOPHYTES

1. To study, identify and comment upon the following algal materials by preparing temporary slides/specimens: *Nostoc*, *Chlamydomonas*, *Volvox*, *Oedogonium*, *Vaucheria*, *Chara*, *Sargassum*, *Batrachospermum* And *Polysiphonia*.
2. To study the morphological and anatomical features of the following material and identify them by preparing temporary slides: *Riccia*, *Marchantia*, *Anthoceros*, *Jungermanniales* and *Funaria*.

PTERIDOPHYTES, GYMNOSPERMS AND ELEMENTARY PALAEOBOTANY

1. Study of the external features, internal structures, rhizome, leaves, roots, sporangia and strobili of *Selaginella* and *Equisetum*, sporocarp of *Marsellia* and prothallus of *Selaginella*, *Equisetum*, *Adiantum* and *Marselia*.
2. Study of the morphological features and anatomical structures of vegetative and reproductive parts of *Cycas*, *Pinus* and *Ephedra*.
3. Study the fossil specimen: Impression, Casts and Petrification.

Second Year

PAPER I (BBO-201) TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

UNIT I

1. Angiosperms origin and evolution. Some examples of primitive angiosperms. Angiosperm taxonomy- fundamental components.
2. Comparison and evolution of the system of classification as proposed by Linnaeus, Betham and Hooker and Hutchinson.
3. Nomenclature: International Code of Botanical Nomenclature (ICBN), History, scientific naming of plants, priority, types, validity, *nomina conservanda*.
4. Collection and preservation techniques of specimens for Herbarium and Museum, Botanical gardens and Herbaria, Botanical Survey of India (BSI).

UNIT II

1. Taxonomy, important distinguishing characters, classification and economics importance of the following families:
Dicotyledonae
Polypetalae : Ranunculaceae, Brassicaceae, Caryophyllaceae, Rutaceae, Malvaceae, Rosaceae and Apiaceae

UNIT III

1. Gamopetalae: Solanaceae, Apocynaceae, Acanthaceae, Lamiaceae
2. Monochlamydae: Euphorbiaceae, Polygonaceae
3. Monocotyledonae: Orchidaceae, Liliaceae, and Poaceae

UNIT IV

1. Origin of cultivated plants, monophyletic and polyphyletic origin, centres of origin of some important crop plants.
2. Origin, history, botanical features and cultivation of cereals and millets: Wheat, Rice, Maize and Bajra.
3. Legumes: An introduction to the economically important legumes.
4. Oils: Castor oil, linseed oil and mustard oil.

UNIT V

1. General account of fruits (Apple, Banana, Citrus, Mango) and Vegetables (Root, stem, leaf, and fruit vegetables).
2. Fibres (Coir, Cotton, Flax, Jute) and Medicinal plants (*Aconitum*, *Atropa*, *Cinchona*, *Rauwolfia*, *Ephedra*).
3. Common Timber yielding plants of Western Himalayas (Chir, Deodar, Sal Shisham and Teak).

Suggested Readings

- Singh, V. And Jain, D.K.2012. Taxonomy of Angiosperms. Rastogi Publications,, Meerut
- Singh, G.2012. Plant Systematic: Theory and Practice. Oxford and IBH Pvt Ltd, New Delhi
- Pandey, B.P.2001. A text book of Angiosperms. S. Chand Publication, New Delhi
- Sharma, O.P.2016. Plants and Human Welfare, Pragati Prakshan, Meerut
- Sharma, A.K. and Sharma, R. Taxonomy of Angiosperms and Utilization of Plants

PAPER II: (BBO-202) ANATOMY, EMBRYOLOGY AND ELEMENTARY MORPHOGENESIS

UNIT I

1. The techniques for the study of plant anatomy.
2. Meristems: Primary and secondary meristems, characteristics and functions. Various types of permanent tissues- Simple and complex tissues.
3. Structure of dicot and monocot root, stem and leaf.

UNIT II

1. Secretory structures
2. Origin structure and function of vascular cambium including anomalous behaviour with special reference to the following taxa: *Bougainvillea*, *Salvadora*, *Nyctanthes*, *Dracaena*, *Orchids* and *Tinospora*.
3. Structure of xylem and phloem.

UNIT III

1. Structure of anther, micro sporogenesis and development of male gametophyte in angiosperms.
Structure of ovule, mega sporogenesis and development of the female gametophyte with reference to the *Polygonum* type. Comparison with the bio sporic and tetra sporic types
2. Pollination, fertilization and life history of a typical angiosperm.

UNIT IV

1. Endosperm and embryo development with special reference to the onagrad type.
2. Polyembryony and apomixis.
3. Seed germination and dormancy, elementary plant movements.

UNIT V

1. Basic body plan of a flowering plant- modular type of growth.
2. Diversity in plant forms in annuals, biennials and perennials. Development of tree habit in higher plants
3. Plant growth regulators: Auxin, Gibberellin, Cytokinin and Abscissic acid.
4. Physiology of flowering: Photoperiodism and vernalization.

Suggested Readings

- Pandey, S.N. 1992, Plant Anatomy, Rastogi Publication, Meerut
Tayal, M.S. 1996, Plant Anatomy, Rastogi Publication, Meerut
Bhojwani, S.S. and Bhatnagar, S.P.1994. Embryology of Angiosperms
Maheshwari, P. An Introduction to Embryology of Angiosperms

PAPER III: (BBO-203) ECOLOGY AND REMOTE SENSING

UNIT I

1. Definition and scope of ecology, Principles of environment, atmosphere, light, temperature, water and soil.
2. Ecosystem: Types , biotic and abiotic components, food chain, food web, ecological pyramids and ecological niche.
3. Productivity, type, measurement of primary productivity, energy flow and ecological energetics, Lindeman's concept of Energy Flow.

UNIT II

1. Biogeochemical cycles: A brief discussion of concept by citing examples of carbon, nitrogen and phosphorous cycles.
2. Population ecology: Definition, population characteristics, growth curves, carrying capacity and population fluctuation.
3. Community ecology: Structure and community characteristics, quantitative, qualitative and synthetic features, life forms, biological spectrum and ecological succession.

UNIT III

1. Pollution of air, water and soil, noise incidence, thermal and radioactive pollution; prevention and control of pollution.
2. Global warming, desertification and ozone depletion.
3. Biogeographical regions of India ; Vegetation types in Uttarakhand

UNIT IV

1. Biodiversity: Basic concept, types, causes and loss of biodiversity.
2. Biodiversity conservation: In situ and ex situ conservation, gene bank, introductory account of Biosphere reserves, National parks and Sanctuaries
3. Soil erosion and conservation, conservation and management of some natural resources: forest and rangeland management.

UNIT V

1. Definition of remote sensing, aerial photography, principles and fundamentals of aerial photo interpretation.
2. Electromagnetic spectrum, satellite and sensors, remote sensing data acquisition, physical basis of remote sensing, aerial and space platforms.
3. Image interpretation, role of remote sensing in ecology.

Suggested Readings

- Odum, E.P. 1983, Basics of Ecology, Saunders College Publication, New York
- Tiwari, S.C.2005. Concepts of Modern Ecology, Bishen Singh Mahendra Pal Singh, Dehradun
- Sharma, P. D, 2014.Ecology and Environment, Rastogi Publications, Meerut
- Shukla, R.S. and Chandel. P.S. 2014. Plant Ecology. S Chand Publications, New Delhi
- Shukla, R.S. and Chandel. P.S. Biostatistics. S Chand Publications, New Delhi

LAB COURSE (BBO-20P)

TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

1. Identification of locally available plants belonging to the families mentioned in the syllabus, their description in semi technical language.
2. Collection of plant specimens: Herbarium and/live specimens. Excursions should be organised to acquaint the students with the local flora.
3. To identify study and comment upon the economically important plants and their economic products mentioned in the syllabus.

ANATOMY, EMBRYOLOGY AND ELEMENTARY MORPHOGENESIS

1. Demonstration of usual techniques of plant anatomy, section cutting, TS, LS of dicot and monocot leaf, stem and root.
2. Normal and abnormal secondary growth in *Boerhavia*, *Bougainvillia*, *Nyctanthes*, , *Dracaena*, *Orchid* and *Tinospora*.
3. TS of anther.
4. Study of various types of pollen grains, placentations, embryo sacs, ovules and stages of embryo development using temporary and permanent preparations.
5. Influence of growth regulators on root formation, senescence and pollen germination (hanging drop method).
6. Structure and organization of the shoot apex/ root apex.

ECOLOGY AND REMOTE SENSING

1. To determine the minimum size of quadrat by species area curve method.
2. To determine the minimum number of quadrats to be laid down for the vegetation analysis of the given area.
3. To determine the frequency, density and abundance of each species in a community by quadrat method.
4. To prepare frequency diagram and compare it with that of the Raunkiaer's normal frequency diagram.
5. To determine the mean basal cover and total basal cover.
6. To study the physical characters of soil in terms of temperature, colour, texture and pH.
7. To find out bulk density and porosity of different soils.
8. To estimate the moisture percentage of various soil samples.
9. Statistical problems of central tendencies, standard deviation, Correlation and X^2 test.
10. Study of types of aerial photographs and satellite data products.
11. Study of types of stereoscopes

THIRD YEAR

Paper I (BBO- 301) CYTOGENETICS, MOLECULAR BIOLOGY AND BIOTECHNOLOGY

UNIT I

1. Structure and functions of Nucleus: Ultra structure, nuclear membrane, nucleolus, structure and functions of other cell organelles: Golgi body, endoplasmic reticulum, peroxysomes and vacuoles. The cell envelope: Plasma membrane, bilayer lipid structure and functions of cell wall.
2. Cell division: Comparison of mitosis and meiosis.
3. Chromosome organization: Morphology, centromere and telomere, chromosome alteration in chromosome numbers, aneuploidy, polyploidy and sex chromosomes.
4. Extra nuclear genome: Presence and functions of mitochondrial and plastid DNA, plasmids.

UNIT II

1. Genetic Inheritance: Mendelism: Law of segregation and independent assortment, incomplete dominance.
2. Interaction of genes: Linkage- complete and incomplete linkage and crossing over.
3. Sex linked inheritance: Determination of sex.
4. Genetic variation: Mutations, transposable genetic elements, DNA damage and repair.

UNIT III

1. DNA,-the genetic material: DNA structure, replication, DNA- protein interaction, the nucleosome model, satellite and repetitive DNA.
2. RNA: Structure and types.
3. Gene concept: Classical and modern concept of gene, operon concept.

UNIT IV

1. Protein Structure: 1D, 2D and 3D structure.
2. Genetic code and protein synthesis.
3. Regulation and gene expression in prokaryotes and eukaryotes.

UNIT V

1. Introduction to Biotechnology: Functional definition, role in modern life, history and ethical issues connected with biotechnology.
2. Genetic engineering: Tools and techniques of DNA technology, cloning vectors, genome, cDNA libraries, transposable elements and techniques of gene mapping.
3. Basic concept of tissue culture, cryopreservation, differentiation and morphogenesis, biology of *Agrobacterium*, vectors for gene delivery and marker genes.
4. A brief account of Industrial biotechnology (fermentation and alcohol production), Agricultural biotechnology (biofertilizers and biopesticides) and Nutritional biotechnology (Mycotoxins and health hazards, control of mycotoxin production, single cell protein).

Suggested Readings

- Gupta P.K. 2000. Cytology, Genetics And Evolution. Rastogi Publication, Meerut
- Gupta P.K. 2012. Genetics. Rastogi Publication, Meerut
- Gupta P.K. 2001. Elements of Biotechnology. Rastogi Publication, Meerut
- Power, C.B. 1994. Cell Biology. Himalaya Publishing House, New Delhi

PAPER II (BBO– 302): PLANT PHYSIOLOGY AND ELEMENTARY BIOCHEMISTRY

UNIT I

1. Cell physiology, diffusion, permeability, plasmolysis, imbibition, water potential and osmotic potential.
2. Types of soil water, water holding capacity, water requirement, wilting coefficient.
3. Active and passive absorption, anatomical features of xylem in relation to path of water transport and ascent of sap.

UNIT II

1. Loss of water from plants, transpiration, factors affecting transpiration, Guttation, anatomy of the leaf with special reference to the loss of water.
2. Structure of stomata, mechanism of stomatal
3. Movement and diffusion capacity of the stomata.
4. Mechanism of absorption of mineral salts.
5. Translocation of solutes, theories and mechanism of translocation. Anatomical features of the phloem tissue with reference to the translocation of solutes.

UNIT III

1. Elementary knowledge of macro and micro nutrients.
2. Symptoms on mineral deficiency, techniques of water and sand culture.
3. Nitrogen cycle and nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation.

UNIT IV

1. Photosynthesis: Historical background and importance of the process, role of primary pigments, concept of two photosystems, Z- scheme, photophosphorylation, Calvin cycle, factors affecting photosynthesis, chemosynthesis.
2. Respiration, glycolysis, Krebs's cycle, Electron transport mechanism (Chemiosmotic theory), ATP- the biological energy currency, redox potential, oxidative phosphorylation, pentose phosphate pathway, CAM plants, factors affecting respiration, fermentation.

UNIT V

1. Types and strength of solutions, acid base and salts, pH, buffer solutions and their importance.
2. Enzyme action, active sites, Michaelis-Menton constant, classification of enzymes, factors affecting the enzyme activity, coenzymes and co factors.
3. Carbohydrates: Classification, properties, structure and biological role.
4. Protein and amino acids: Classification, structure and chemical bonds in protein structure and properties.
5. Lipids: Structure and functions, fatty acid biosynthesis, beta- oxidation, saturated and unsaturated fatty acids, storage and mobilization of fatty acids.

Suggested Readings

- Jain, V.K. 2014. Fundamentals of Plant Physiology. S. Chand Publications, New Delhi
Verma, S.K. and Verma M.2014. A text book of Plant Physiology and Biochemistry. S. Chand Publications, New Delhi
Devlin, R.M. 1996, Plant Physiology. Indian Print New Delhi
Pandey, S.N.2000. Plant Physiology.
Srivastava, H.S. Biochemistry. Rastogi Publication, Meerut

PAPER III: (BBO- 303) PLANT BREEDING AND BIOSTATISTICS

UNIT 1

1. Plant breeding: Aims and objectives, basic techniques of plant breeding.
2. Methods of plant breeding in relation to self pollinated and cross pollinated plants.

UNIT 2

1. Crop improvement methods: Plant introduction, selection, acclimatization and hybridization, vegetative propagation and grafting.
2. Heterosis: Genetic and physiological basis
3. Mutational breeding and breeding for disease resistance.

UNIT 3

1. Improved seed production, multiplication and distribution.
2. Maintenance and seed testing.
3. National Seed Corporation (NSC), seed testing laboratories, International and National Centre for plant breeding.

UNIT IV

1. Bio-statistics and its applications.
2. Methods of representation of statistical data diagrams.
3. Measurements of Central tendencies: Mean, Median and Mode

UNIT V

1. Measures of dispersion: Range, mean deviation, standard deviation and standard error.
2. Coefficient of correlation.
3. Test of significance: Chi- square test.

Suggested Readings

Singh, B.D. 2002. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi

Chaudhary, H.C. Plant Breeding

Banerjee, P.K. 2007. Introduction to Biostatistics

Prasad, Satguru, 1992. Fundamentals of Biostatistics

LAB COURSE (BBO30P)
CYTOGENETICS, MOLECULAR BIOLOGY AND BIOTECHNOLOGY

1. To study Prokaryotic cells (Bacteria) and Eukaryotic cells with the help of light and electron micrographs.
2. To study cell structure from onion leaf peels, demonstration of staining and mounting methods.
3. Study of mitosis and meiosis (temporary mounts and permanent slides).
4. Exercises on genetical problems out of the following : Mendel's Law Of Inheritance, Incomplete Dominance, Sex Linked Inheritance, Sex Determination, Cytoplasmic Inheritance.
5. To study the working of following instruments: Incubator, Water Bath, Spectrophotometer, Oven and Centrifuge.
6. To study about life history of various scientists and their contribution in the field of molecular biology.
7. To study the working of the following instruments PCR, Laminar Airflow, Autoclave, etc
8. Culture media preparation.
9. Comment upon the given photograph, specimens, slides etc.

PLANT PHYSIOLOGY AND ELEMENTARY BIOCHEMISTRY

1. To perform endosmosis and exosmosis using potato tuber and egg osmoscope. Demonstration of imbibition, plasmolysis and deplasmolysis.
2. To study the effects of temperature on the permeability of plasma membrane.
3. Structure of stomata, their opening and closing, stomatal frequency.
4. Comparison of the rate of transpiration using four leaf method, cobalt chloride paper or by different types of potometers under different climatic conditions.
5. Separation of photosynthetic pigments by circular paper and strip chromatography.
6. To study the effect of light and darkness on starch synthesis.
7. To study the effect of intensity and quality of light on the rate of photosynthesis by Wilmott's bubbler.
8. Study of R.Q by Ganong's respirometer in different seeds.
9. Comparison of the rate of respiration of various plants.
10. Demonstration of colour tests and micro- chemical tests for carbohydrates, proteins and lipids.

PLANT BREEDING AND BIostatISTICS

1. Study of the floral biology of some of the locally available crops such as Wheat, Pea, Bean, Mustard, Brinjal, Orka, Tomato etc.
2. Emasculation techniques in the field along with bagging and labelling.
3. Estimation of dockage percentage in seed samples.
4. Estimation of moisture content in seed samples.
5. National and International Institutes of crop research and improvement, their abbreviations.
6. Representation of data through graphs and diagrams.
7. Comment upon given graphs and diagrams.
8. Statistical problems of Central Tendencies, Standard Deviation, Correlation and Chi Square Test.

Department of Zoology

B.Sc. (Zoology)

Course Contents & Syllabus

Agarwal

**Sri Dev Suman Uttarakhand Vishwavidhyalay,
Badshahithaul, Tehri Garhwal, Uttarakhand 249 199.**

B.Sc. Course in Zoology

Sri Dev Suman Uttarakhand Vishwavidhyalay, Badshahithaul,
Tehri Garhwal, Uttarakhand 249 199.

Syllabus: Theory

The B.Sc. examination will be spread over three years (six semester). There shall be two theory papers and one practical examination every semester. Each theory paper has been divided into four units. Each paper will be of 100 marks (Theory-80, Sessional-20). Likewise, each practical will be of 50 marks (Theory-40, Sessional-10).

Course Contents & Teaching Schedules:

B.Sc. First Year	No. of Lectures	MM
1st Semester		
Paper 1 : Non-Chordata		
Paper 2 : Cell Biology & Genetics	36	100
Practical: Based on paper 1 and 2	36	100
	72	50
2nd Semester		
Paper 3: Chordata		
Paper 4: Taxonomy, Evolution	36	100
Practical: Based on paper 3 and 4	36	100
	72	50
B.Sc. Second Year		
3rd Semester		
Paper 5: Physiology & Biochemistry	36	
Paper 6: Developmental Biology & Endocrinology	36	
Practical: Based on paper 5 and 6	72	
4th Semester		
Paper 7: Ecology and Environment	36	100
Paper 8: Animal Behaviour & Conservation Biology	36	100
Practical: Based on paper 7 and 8	72	50
B.Sc. Third Year		
5th Semester		
Paper 9: Molecular Biology and Biotechnology	36	100
Paper 10: Microbiology and Immunology	36	100
Practical: Based on paper 9 and 10	72	50
6th Semester		
Paper 11: Economic Zoology	36	100
Paper 12: Biostatistics and Computer	36	100
Practical: Based on paper 11 and 12	72	50

Agarwal

B.Sc. Course in Zoology

Sri Dev Suman Uttarakhand Vishwavidhyalay, Badshahithaul,
Tehri Garhwal, Uttarakhand 249 199.

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Practical: Based on paper 3 and 4	72	50
B.Sc. Second Year		
3rd Semester		
Paper 5: Physiology & Biochemistry	36	
Paper 6: Developmental Biology & Endocrinology	36	
Practical: Based on paper 5 and 6	72	
4th Semester		
Paper 7: Ecology and Environment	36	100
Paper 8: Animal Behaviour & Conservation Biology	36	100
Practical: Based on paper 7 and 8	72	50
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5th Semester		
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6th Semester		
Paper 11: Economic Zoology	36	100
Paper 12: Biostatistics and Computer	36	100
Practical: Based on paper 11 and 12	72	50

Agarwal

**B.Sc. 1st Year (Zoology)-1st Semester
Paper I: Animal Diversity (Non-Chordata)**

	No. of Lectures
UNIT-I Protozoa: General characters and classification up to classes; locomotion and nutrition in Protozoa. Porifera: General characters and classification up to classes; Canal system in sponges.	9.0
UNIT-II Coelenterata: General characters and classification up to classes; Polymorphism in Coelenterates; Corals and coral reefs. Helminthes: General characters of Nematelminthes and Platyhelminthes; Life history of <i>Ascaris lumbricoides</i> and <i>Taenia solium</i> and their parasitic adaptations.	9.0
UNIT-III Annelida: General characters and classification up to classes; Metamerism in Annelida; Trochophore larva and its significance. Arthropoda: General characters and classification up to classes; Zoological importance of <i>Peripatus</i> and <i>Limulus</i> . Metamorphosis in Insects.	9.0
UNIT-IV Mollusca: General characters and classification up to classes; Torsion in Gastropoda; Pearl formation Echinodermata: General characters and classification up to classes; Water vascular system in star fish; Echinoderm larvae and their significance.	9.0

Books Recommended:

1. Kotpal, Agrawal & Khetrapal: Modern Text-book of Zoology, Invertebrates.11/E. Rastogi publication.
2. Marshall & William: Text book of Zoology, Vol I (Parker & Haswell, 7th ed.) Macmillan,.
3. Nigam: Biology of Non-Chordates, Nagin Chand,.
4. B.Sc. Zoology Series -Animal Diversity ,Tata McGraw Hill Edu Pvt. Ltd. N.Delhi
5. Jordan E.L. et al.: Invertebrate Zoology. S.Chand & Company Ltd.
6. Barnes: Invertebrate Zoology (4th ed.), Holt-Saunders.
7. Barrington: Invertebrate Structure and Function, Nelson.
8. Iyer: A Manual of Zoology, Part I. Visawanathan,

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**B.Sc. 1st Year (Zoology)-1st Semester
Paper 2: Cell Biology and Genetics**

	No. of Lectures
UNIT-I Generalized structure of Pro- & Eukaryote cell. Elementary knowledge of the structure & function of plasma membrane. Introduction to the organelles constituting endo-membrane system (Endoplasmic reticulum, Golgi complex, Lysosome).	9.0
UNIT-II Nucleus & nucleolus; Ribosome; Mitochondria. Introduction to cytoskeleton. Cell Division-Mitosis & Meiosis. Basic features of Cell cycle; Elementary idea of cell transformation and cancer.	9.0
UNIT-III Mendel's law; Exceptions to Mendel's law. Incomplete dominance and Co-dominance, Multiple alleles, Lethal alleles, Epistasis. Sex-linked inheritance; Extra chromosomal inheritance.	9.0
UNIT-IV Linkage & Crossing over. Sex determination. Chromosome structure; Euchromatin; Heterochromatin; Histones. Polytene & lampbrush chromosomes, Eugenesis,	9.0

Books Recommended

1. Alberts et al.: Molecular Biology of the Cell, Garland Publ., New York, 1989.
2. Strickberger: Genetics, Prentice Hall, 1996.
3. DeRobertis & DeRobertis: Cell & Molecular Biology, 1996
4. Gupta P.K. : Cell And Molecular Biology, Rastogi Publications
5. Sarkar B : Cell Structure and Function, Medtech
6. Verma & Agarwal: Cell Biology, genetics, Molecular Biology. S.Chand & Company

PRACTICAL SYLLABUS B.Sc. 1st SEMESTER (Zoology)

A. Non-Chordata:

- Kingdom Protista: Amoeba, Euglena, Plasmodium, Paramecium
Phylum Porifera: Sycon (including T.S. and L.S.), Hyalonema, and Euplectella
Phylum Cnidaria: Obelia, Physalia, Aurelia, Tubipora, Metridium
Phylum Platyhelminthes: Liver Fluke, Taenia solium and Study of its life history stages
Phylum Nematelminthes: Male and female Ascaris lumbricoides
Phylum Annelida: Aphrodite, Nereis, Pheretima, Hirudinaria
Phylum Arthropoda: Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Apis, Peripatus
Phylum Mollusca: Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus
Phylum Echinodermata: Pentaceros, Ophiura, Echinus, Cucumaria and Antedon

An "animal album" containing photographs, cut outs, with appropriate write up about the above mentioned taxa.

B. Cell Biology and GENETICS:

1. Cell Structure and Cell Division- Prepared slides/photographs
2. Preparation of giant chromosome
3. Preparation of onion root tip for the stage of mitosis
4. Using suitable examples of Mendelian Inheritance and gene interactions verify the results through Chi-square test.
5. Study of Linkage, recombination, gene mapping using the data.
6. Study of Human Karyotypes (normal and abnormal).

Distribution of marks:

Duration 4 hrs.

1. Spotting (10) (Protozoa to Echinodermata)	20
2. Exercise on Cell Biology	05
3. Exercise on Genetics	05
4. Record and Collection	05
5. Viva Voice	05
6. Sessional Marks	10

Total

50

Agarwal

**B.Sc. 1st Year (Zoology)-2nd Semester
Paper 3: Chordata**

	No. of Lectures
UNIT- I Protochordates: General features and Phylogeny of Protochordats. Body organization of <i>Balanoglossus</i> , <i>Herdmania</i> and <i>Amphioxus</i> .	9.0
UNIT- II Agnatha: General features of Agnatha and classification of cyclostomes up to Classes, Comparison between Lampreys and Hagfishes. Pisces: General features and Classification up to orders; Scales and fins of fishes, Hill stream adaptations	9.0
UNIT- III Amphibia: General features and Classification up to orders; Parental care; Neoteny Reptiles: General features and Classification up to orders; Poisonous and non-poisonous snakes; Biting mechanism in snakes; Venum and antivenum.	9.0
UNIT- IV Aves: General features and Classification up to orders; Feathers in Birds; Adaptations for aerial mode of life; Mammalia: Origin of mammals; General organization, distribution and affinities of Prototheria, Metatheria and Eutheria; Aerial and aquatic adaptations in mammals.	9.0

Books Recommended:

1. Pandey B.N. and Mathur V. Biology of Chordates, PHI Learning, 2018
2. R.L. Kotpal: Modern Text-book of Zoology, Vertebrates. Rastogi Publication.
3. E.L. Jordan and P.S. Verma: Chordate Zoology. S. Chand & Co. Ltd.
4. Hildebrand: Analysis of Vertebrate structure.
5. Romer & Parsons: The Vertebrate Body, Saunders.

**B.Sc. 1st Year (Zoology) - 2nd Semester
Paper 4: Taxonomy and Evolution**

	No. of Lectures
UNIT-I Taxonomy: Definition & scope; relationship with Systematic Zoological nomenclature: Binominal & Trinominal; ICZN. Components of classification: Linnaean hierarchy. Concepts of species: Typological, Nomenclastic & Biological	9
UNIT-II Geological distribution of animals, period of evolution and extinction of major groups. Direct Evidences of Evolution: Type of Fossils & fossilization. Dating of fossils. Significance of fossil record. Evolution of Horse.	9
UNIT- III Evolutionary theories: Lamarckism, Darwinism, Neo-Darwinism; Processes of Evolutionary Change: Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection	9
UNIT-IV Species Concept: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric), Macro-evolutionary principles (example: Darwin's Finches), Role of extinction in evolution	9

Books Recommended:

1. Ashok Verma - Animal Taxonomy
2. Ernst Mayr- Principals of Systematic
3. Simpson- Principals and Practices of Animal Taxonomy
4. Kapoor- Theory and Practices of Animal Taxonomy, Oxford & Ibh
5. Strickberger: Evolution, CBS Publ. 1994.
6. Douglas, J. Futuyma. *Evolutionary Biology*. Sinauer Associate (1997)
7. Jain P.C. : Paleontology, Vishal Publ. Co.
8. Arora M.P.: Organic Evolution, Himalaya Publ.

PRACTICAL SYLLABUS B.Sc. 2nd SEMESTER (Zoology)

A. Chordata:

Protochordata: *Balanoglossus*, *Herdmania*, *Branchiostoma*, *Agnatha*: *Petromyzon*
Pisces: *Sphyrna*, *Pristis*, *Torpedo*, *Labeo*, *Exocoetus*, *Anguilla*, *Tor putitora*, Hill stream fishes
Amphibia: *Ichthyophis/Ureotyphlus*, *Salamandra*, *Bufo*, *Hyla*, *Axolotal larva*
Reptilia: *Chelone*, *Hemidactylus*, *Chamaeleon*, *Draco*, *Vipera*, *Naja*, *Crocodylus*, *Gavialis*
Key for Identification of poisonous and non-poisonous snakes
Aves: Study of six common birds from different orders
Mammalia: *Sorex*, *Bat*, *Funambulus*, *Loris*,

An "animal album" containing photographs, cut outs, with appropriate write up about the above mentioned taxa.

B. COMPARATIVE ANATOMY

1. Osteology:

- Disarticulated skeleton of fowl and rabbit
- Carapace and plastron of turtle /tortoise
- Mammalian skulls: One herbivorous and one carnivorous animal.

C. EVOLUTION:

- Study of fossil evidences from plaster cast models and pictures
- Study of homology and analogy from suitable specimens/ pictures and charts:
- Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
- Darwin's Finches with diagrams/ cut outs of beaks of different species
- Visit to Natural History Museum, submission of report

Distribution of marks:

Duration 4 hrs.

1. Spotting (10) (Protochordate to Mammals, Bones)	20
2. Exercise on Evolution	05
3. Permanent slide making (Fish scale,)	05
4. Record and Collection	05
5. Viva Voice	05
6. Sessional Marks	10

Total

50

Agarwal

**B.Sc. 2nd Year (Zoology)- 3rd Semester
Paper-5 Animal Physiology and Biochemistry**

No. of
Lectures

UNIT- I

Digestion: Intracellular and Extracellular digestion. Digestion and absorption of Carbohydrates, Lipids and Proteins.
Respiration: Pulmonary ventilation, Respiratory volumes and capacities.
Transport of Oxygen and Carbon dioxide in Blood. Dissociation of oxyhaemoglobin,

9

UNIT- II

Circulation: Composition of blood; Blood coagulation; Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle.

9

Excretion: Structure of nephron; Physiology of urine formation.

UNIT- III

Nervous system: Types of neurons; Myelinated and non-myelinated nerve fibres. Initiation and conduction of nerve impulse; Resting and action potential; Synapse and chemical transmission.

9

Muscles: Types of muscles; Ultrastructure of skeletal muscles; Molecular and Chemical basis of muscle contraction; Brief idea of tetanus and fatigue.

UNIT – IV

Carbohydrates Metabolism: Glycolysis, Krebs's Cycle, Gluconeogenesis, Glycogenesis and Glycogenolysis; Lipids: Biological significance, structure and classification.

9

Proteins: Transamination, Deamination and Urea Cycle

Enzymes: Mechanism of enzyme Action, Kinetics, Inhibition and Regulation.

Books recommended:

1. Singh & Neeraj: Graduate Animal Physiology & Biochemistry, Vishal Publ
2. Prosser and Brown: Comparative Animal Physiology, Wiley.
3. Nielson: Animal Physiology, Cambridge.
4. Jain A.K: Textbook Of Physiology 6/E, Avichal Publishing Company
5. Conn and Stumpf: Outlines of Biochemistry. John Wiley.
6. Pandey B N: B.Sc. Zoology Series-Biochemistry, Physiology, Endocrinology; Tata McGraw Hill Edu Pvt. Ltd. N. Delhi

**B.Sc. 2nd Year (Zoology)- 3rd Semester
Paper-6 Developmental biology and Endocrinology**

	No. of Lectures
UNIT- I Gametogenesis: Spermatogenesis in mammals, Morphology of mature mammalian spermatozoon: Oogenesis in mammals, Vitellogenesis in birds. Fertilization: external (amphibian), Internal (mammals), Block to polyspermy.	9
UNIT- II Early Development of Frog and Human: types of egg; patterns of cleavage; role of yolk during cleavage; Morphogenetic movements; Development up to formation of gastrula. Fate Map, Fate of germ layers. Neurulation in frog embryo, Extra embryonic membranes,	9
UNIT- III Implantation of embryo in human; Types of placenta on the basis of histology; Formation of human placenta and its functions. Fundamental process in development (brief idea): gene activation, determination, Elementary concept of primary organizer; Induction. Differentiation and organogenesis of vertebrate eye. Metamorphic events in frog life cycle and its hormonal regulation	9
UNIT – IV Basic idea of endocrine, paracrine & autocrine secretion. Mechanism of action of hormones. Structure and function of Pituitary, Thyroid, Adrenal, Pancreas, Testes and ovary. Hormonal control of menstrual cycle	9

Books recommended:

1. Jain P C . Development Biology.
2. Gilbert, Developmental Biology. 3rd ed. Sinauer, 1991.
3. Berril: Developmental Biology, McGraw-Hill. Indian ed. 1974.
4. Laycock, J.F. and Wise, P.H.: Essential Endocrinology. Oxford University Press.
5. Hadley, M.E.: Endocrinology. Pearson Education Pvt. Ltd. Singapore.

PRACTICAL SYLLABUS of B.Sc. 3rd SEMESTER (Zoology)

A. Physiology

1. Preparation of hemin crystals
2. Estimation of Haemoglobin percentage
3. Blood group test
4. Examination of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage etc.

B. BIOCHEMISTRY

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose)
2. Colour reactions to identify functional group in the given solution of proteins
3. Study of activity of salivary amylase under optimum conditions

C. DEVELOPMENTAL BIOLOGY and Endocrinology

1. Frog - Study of developmental stages - whole mounts and sections through permanent Slides- cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole-external and internal gill stages.
2. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.
3. Study of placental development in humans by ultrasound scans.
4. Examination of gametes -sperm and ova (frog/mammals) through permanent slides or photomicrographs.
5. Examination of histological section of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal, Testes, Ovary.

Distribution of marks:

Duration 4 hrs.

7. Spotting (10) (Histology, Endocrine glands and Embryology)	20
8. Exercise on Physiology	05
9. Exercise on Biochemistry	05
10. Record and Collection	05
11. Viva Voice	05
12. Sessional Marks	10
Total	50

Agarwal

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**B.Sc. 2nd Year (Zoology)- 4th Semester
Paper 7: Ecology and environment**

	No. of Lectures
UNIT-I Ecology: Definition, scope and importance, Introduction to laws of Limiting factors: Liebig's law of the minimum, Shelford's law of tolerance. Factor interaction. Biogeochemical cycles: Concept and types of biogeochemical cycle (Water, Carbon, Nitrogen and Phosphorus cycle)	9
UNIT-II Ecosystem concept: Component & types (Grassland, Forest, Pond, River); Abiotic, biotic & edaphic factors and their interdependence, Energy flow in ecosystem. Primary and secondary productivity. Food chains, food web and ecological pyramids,	9
UNIT-III Population: Definition; Biotic potential; Density, Natality, Mortality & population growth curves; Carrying capacity. Community: Definition, concept and characteristics; Density, Dominance; Diversity and stratification.	9
UNIT-IV Environmental pollution: Definition, Types, Sources & effect (Air, Water, solid waste & Radioactive pollution). Green house effect, Climate change, Acid rain, Ozone layer depletion, Environmental Impact assessment	9

Books recommended:

1. Odum, E.P.: Fundamentals of Ecology, Saunders Co. Publ. 1971/1993 Indian ed.
2. Chapman & Reiss: Ecology.
3. Smith, R.L.: Ecology & Field Biology.
4. Singh & Kumar: Ecology and Environmental Science, Vishal Publ. Co., 2004.

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B.Sc. 2nd Year (Zoology)- 4th Semester
Paper 8: Animal Behaviour & Conservation Biology

	No. of Lectures
UNIT I: The science of behaviour: History, scope and terminology. Proximate and ultimate causes of behaviour. Instinct: Definition and Characteristics (sign stimuli and Fixed Action Pattern). Learning behaviour: Definition. Spatial learning. Associative learning, classical conditioning, operant conditioning, language learning. Imprinting. Kin recognition. Instinct versus learning behaviour.	9
UNIT II: Biological rhythms. The Biological Clock. Circadian rhythms and their Synchronization. Seasonal rhythms. Photoperiodism. Communication: Visual, olfactory, acoustic. Chemoreception: Chemicals (pheromones) as signals in insects, fish and mammals. Hormonal Control of behaviour. Cooperation and conflict. Evolution of altruism.	9
UNIT III Conservation Biology: Definition & scope. Concept of biodiversity; Biodiversity as a resource; Biodiversity loss and its Causes. Conservation & Management of Biodiversity. Concept of Protected Areas: <i>Ex-situ</i> & <i>In-situ</i> Conservation. Biodiversity hot spots.	9
UNIT IV India's wildlife: Habitats & Distribution; Protected areas: National Parks & Sanctuaries. National Organizations involved in wild life conservation; Wild life Legislation: Wild life Protection act - 1972, its amendments and implementation; Zoogeography of India. Vertebrate fauna of Garhwal Himalaya (Distribution, habitat preference, adaptive features).	9

Recommended Books:

1. Alcock : Animal behaviour Sinaur Associates, Inc. 1989.
2. Drickamer & Vessey: Animal Behaviour: Concepts, Processes and Methods (2nd ed.)1986
3. Goodenough et al.: Perspectives on animal behaviour. Wiley & Sons, New York. 1993.
4. Grier : Biology of animal behaviour, Mosby 1984.
5. M P Arora. Anilam behaviour. Himalayan Publishing house
6. Negi: An introduction to Wildlife Management, 1983.
7. Negi: Himalayan Wildlife: Habitat and Conservation. 1992. Indus Publ. Com., New Delhi.
8. Pullin: Conservation Biology, Cambridge, 2002.
9. Rawat & Agarwal : Biodiversity: Concept, threats and conservation.
10. Sharma, High Altitude Wildlife of India. Oxford 7 IBH Publ. Co. Pvt. Ltd. 1994.

PRACTICAL SYLLABUS of B.Sc. 4th SEMESTER (Zoology)

A. Ecology & Environment

1. Models Based on different aspects of ecology.
2. Population study of available terrestrial and aquatic animals
3. Physico-chemical study of soil and water (pH, DO, Free CO₂, Turbidity etc)
4. Study of an ecosystem, its biotic components and food chains

B. Animal Behavior & Conservation Biology

1. Models Based on different aspects of animal behavior.
2. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna through photographs/models
3. Study of Birds Nest showing Nesting Behaviour
4. Experiments related to learning behaviour/conditional learning.

Distribution of marks:

Duration 4 hrs.

13. Spotting (05) (Ecological adaptation, Wildlife, Animal behaviour)	15
14. Exercise on Ecology/ Conservation Biology	10
15. Exercise on Animal Behaviour	05
16. Record and Collection	05
17. Viva Voice	05
18. Sessional Marks	10

Total

50

Agarwal

**B.Sc. 3rd Year (Zoology)- 5th Semester
Paper-9: Molecular Biology and Biotechnology**

	No. of Lectures
UNIT I Structure of DNA: nucleosides, nucleotides, polynucleotide chain, Watson and Crick DNA double helix model, DNA as genetic material, Packaging of DNA, Types of DNA.	9
UNIT II Enzymes involved in prokaryotic and eukaryotic DNA replication; Mechanism & Type of replication. DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair.	9
UNIT III RNA: Structure and types of RNA, Clover leaf model of tRNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. Processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.	9
UNIT IV Biotechnology: Definition and scopes; Enzyme used in genetic engineering, Recombinant DNA technology, DNA fingerprinting. A Brief knowledge of PCR and its significance. Biotechnological innovations in the area of medical, agriculture, industrial and forensic sciences.	9

Books recommended:

1. Alberts et al.: Molecular Biology of the cell. Garland Publ., New York.
2. De Robertis- Cell and Molecular Biology
3. Friefelder: Molecular Biology. Narosa Publ. House.
4. Smith: Biotechnology. Cambridge.
5. Verma, P.S. and Agrwal, V. K. Cell Biology, Genetics, Molecular biology, Evolution and Ecology (S. Chand & Co.)

**B.Sc. 3rd Year (Zoology)- 5th Semester
Paper-10: Microbiology and Immunology**

	No. of Lectures
UNIT – I General account of different groups: Cyanobacteria, fungi, yeast, viruses, Bacteria: Structure, classification, nutrition and reproduction.	9
UNIT-II Microbiology Techniques: Media preparation, sterilization, pure culture and staining techniques. General structure and multiplication of Viruses; General characteristics of bacteriophages.	9
UNIT-III Overview of the immune system- Introduction to basic concepts in immunology, Components of immune system, principles of innate and adaptive immune system; Cells and organs of the immune system: Haematopoeisis, primary and secondary lymphoid organs.	9
UNIT-IV Antigens- Basic properties of antigens, B and T cell epitopes, haptens and adjuvants; Antibodies- Structure, classes and function of antibodies, monoclonal antibodies.	9

SUGGESTED READINGS

1. Delves, Martin, Burton, Roitt, 2006. Roitt's Essential of Immunology. XI Ed., Blackwell Publi.
2. Kindt, Goldsby, Osborne, Kuby, 2006. Immunology. VI Ed. W.H. Freeman and Company.
3. Parija- Text book of Microbiology
4. Tortora- Microbiology: an Introduction

PRACTICAL SYLLABUS of B.Sc. 5th SEMESTER (Zoology)

A. Molecular biology and Biotechnology:

1. Study of Watson & Crick Model of DNA through model/photographs
2. Study of Clover leaf structure of tRNA through model/photographs
3. Isolation of chromosomal DNA from bacterial cells.
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples

B. Microbiology and Immunology:

1. Media preparation and sterilization,
2. Inoculation
3. Gram's staining of Bacterial Cell
4. Study of lymphoid organs- Thymus, Spleen etc (by slides or photo micrographs)
5. Study of different classes of antibodies through photographs
6. ABO blood group determination
7. Demonstration of immunoelectrophoresis

Duration 4 hrs.

Distribution of marks:

1. Spotting (05)	15
2. Exercise on Molecular Biology/Biotechnology	05
3. Exercise on Immunology	05
4. Exercise on Microbiology	05
5. Record and Collection	05
6. Viva Voice	10
7. Sessional Marks	
Total	50

Agarwal

B.Sc. 3rd Year (Zoology)- 6th Semester
Paper 11: Economic Zoology

	No. of Lectures
UNIT I Elementary knowledge of Sericulture, Apiculture and Lac culture. Elementary knowledge of Poultry Keeping.	9
UNIT II Elementary Knowledge of Fish culture; Genetic improvements in aquaculture industry; Induced breeding and transportation of fish Seed. Elementary knowledge of Animal Husbandry, Preservation and artificial insemination in cattle.	9
UNIT III Parasitic protozoa and human diseases (Life history and pathogenicity of <i>Plasmodium vivax</i> and <i>trypanosoma gambiense</i>), Parasitic helminthes and human diseases (Life history and pathogenicity of <i>Schistosoma</i> , and <i>Wuchereria bancrofti</i>)	9
UNIT IV Life cycle, medical importance and control of <i>Anopheles</i> , <i>Aedes</i> , and <i>Xenopsylla cheopis</i> . Biology, Control and damage caused by <i>Helicoverpa armigera</i> and <i>Pyrilla perpusilla</i> , Safe storage of stored grains. Integrated Pest Management (IPM)	9

Books Recommended:

1. Arora and Arora: *Medical Parasitology*. II Edition. CBS Publications and Distributors.
2. Atwal (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
3. Dunham (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches*. CABI publications, U.K.
4. Hafez (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
5. Jabde.: *Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac Culture, agricultural Pests and their Control*. Discovery Publishing House.
6. Park :*Preventive and Social Medicine*. XVI Edition. B.B Publishers.
7. Pedigo (2002). *Entomology and Pest Management*, Prentice Hall.
8. Ravindranathan: *Economic Zoology*. Vedant eBook (P) Ltd. New Delhi.
9. Shukla & Upadhyay: *Economic Zoology*. 4th Ed. Rastogi Publ., Meerut.
10. Sobti: *Medical Zoology*. Sobhan Lal Nagin Chand & Co. Jallendhar.

B.Sc. 3rd Year (Zoology)- 6th Semester
Paper 12: Biostatistics & Computer

	No. of Lectures
UNIT-I Biostatistics as a tool in research. Data collection: Random & non-random sampling. Data tabulation; Data presentation (Graph, Frequency Polygon, Histogram, Bar diagram, Scatter diagram).	9
UNIT-II Measures of central tendency- Calculation of Mean, Mode, Median, Geometric mean, Harmonic mean	9
UNIT-III Measure of dispersion- Variability and statistics of dispersion, Range, Mean deviation, Standard deviation, Coefficient of variation, Standard error of means.	9
UNIT-IV Capabilities and limitations of computers; Components of computer (Input unit, Memory, Central Processing Unit, Output unit). Problem solving with computers. Elementary idea of memory (RAM, ROM). Uses of computers in different fields. e.g. Biology, Medical, Environment etc.	9

Books Recommended:

1. D. Rajaraman & V. Rajaraman: Computer Primer (2nd ed.) Prentice Hall of India, New Delhi.
2. Mahajan: Methods in Biostatistics, (4th ed.) Jaypee Bros. 1984.
3. Roger Hunt & John Shelley; Computer and Commonsense, Prentice Hall of India, New Delhi
4. Zar: Biostatistical Analysis, Pearson Education (3rd Indian Reprint) 2005

PRACTICAL SYLLABUS of B.Sc. 6th SEMESTER (Zoology)

A. Economic Zoology

1. Study of permanent slides/photomicrographs and specimens of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Schistosoma haematobium*, *Ancylostoma duodenale* and *Wuchereria bancrofti*
2. Study of arthropod vectors associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes* etc
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Helicoverpa (Heliothis) armigera*, *Papilio demoleus*, *Pyrilla perpusilla*
5. Visit to poultry farm or animal breeding centre. Submission of visit report
6. Maintenance of freshwater aquarium

B. Biostatistics

Practical application of statistics- Data presentation (Bar diagram, Histogram, Frequency distribution curve and scattered diagram), Measures of central tendency and dispersion.

C. Computer application

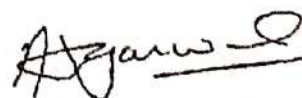
Practical demonstration –preparation of Power Point presentation, Spread sheet, Chart and Design etc.

Distribution of marks:

Duration 4 hrs.

1. Spotting (10) (Economic zoology)	20
2. Exercise on Biostatistics	05
3. Exercise on Computer Application	05
4. Record and Collection	05
5. Viva Voice	05
6. Sessional Marks	10

Total **50**



DEPARTMENT OF PHYSICS

Sridev Suman Uttarakhand University,
Badshaithaul, Tehri Garhwal



Syllabus
For
Undergraduate Courses
2020-2021
(Annual System)

This syllabus will be prospective and will be enforced at the entry level from the academic year

B. Sc. Part I

PHYSICS

PAPER-I: MECHANICS

UNIT I: Laws of Motion and Conservation Laws

Laws of Motion: Frames of reference, Inertial and Non-inertial frames of reference, Newton's Laws of motion, Dynamics of a system of particles, Centre of Mass, Motion of centre of mass.

Momentum and Energy: Conservation of momentum, Work and energy, Work energy principle, Conservative forces, Conservative force as the negative gradient of potential energy, Conservation of energy, System of variable mass-Motion of rockets.

UNIT II: Rotational Motion

Angular velocity and angular momentum, Torque, Conservation of angular momentum, Equation of motion, Moment of inertia, Theorem of parallel and perpendicular axis, Moment of inertia of rod, rectangular lamina, ring, disc, solid sphere, spherical shell, Kinetic energy of rotation, Rolling along a slope.

UNIT III: Gravitation

Newton's Law of Gravitation, Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Gravitational field, potential and potential energy, Gravitational potential and field intensity for spherical shell, Kepler's Laws of planetary motion, Satellite in circular orbit and applications, Geosynchronous orbits, Basic idea of global positioning system (GPS).

UNIT IV: Elasticity:

Hooke's law- Stress-strain diagram, Elastic moduli-Relation between elastic constants, Poisson's Ratio, Expression for Poisson's ratio in terms of elastic constants, Work done in stretching a wire and work done in twisting a wire, Twisting couple on a cylinder, Determination of Rigidity modulus by static torsion, Torsional pendulum, Determination of Rigidity modulus and moment of inertia (Y , η and σ) by Searle's method.

UNIT V: Fluids:

Surface Tension: Synclastic and anticlastic surface, Excess of pressure: Application to spherical and cylindrical drops and bubbles, Variation of surface tension with temperature - Jaegar's method.

Viscosity: Viscosity - Rate flow of liquid in a capillary tube, Bernoulli's theorem, Poiseuille's formula, Determination of coefficient of viscosity of a liquid, Variations of viscosity of a liquid with temperature.

Reference Books:

- University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley
- Mechanics Berkeley Physics course, vol1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
- Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Mechanics: D. S. Mathur and P. S. Hemne, S Chand Publications, 2014, New Delhi.
- Mechanics: J. C. Upadhyaya, Ram Prasad and Sons, Agra.
- Mechanics and General Properties of Matter: P. K. Chakrabarti, Books and Allied Pvt. Ltd.

B. Sc. Part I

PHYSICS

PAPER-II: ELECTRICITY AND MAGNETISM

UNIT I: Vector Field:

Scalar and Vector field, Gradient, Divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors.

UNIT II: Electrostatics:

Electrostatic Field, electric flux, Gauss's theorem of electrostatics, Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, Electric field and potential as line integral of electric field, electric potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere, Calculation of electric field from potential, Capacitance of an isolated spherical conductor, Parallel plate, spherical and cylindrical condenser, Energy per unit volume in electrostatic field, Dielectric medium, Polarization, Displacement vector, Parallel plate capacitor completely filled with dielectric.

UNIT III: Magnetostatics:

Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current, Lorentz force, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia-, para- and ferromagnetic materials.

UNIT IV: Electromagnetic Induction and Alternating current:

Field due to Helmholtz coil, solenoid and current loop, Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, Self-inductance (L) of single coil, mutual inductance (M) of two coils, Energy stored in magnetic field, Alternating current, Alternating voltage across R-C, L-C, R-L and LCR circuits, condition of resonance.

UNIT V: Maxwell's equations and Electromagnetic wave propagation:

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

Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
- Electricity and Magnetism, J. H. Fewkes and J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Electricity and Magnetism, D. C. Tayal, 1988, Himalaya Publishing House.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Introduction to Electrodynamics, D. J. Griffiths, 3rd Edn, 1998, Benjamin Cummings.
- Electricity and Magnetism, K. K. Tiwari, 3rd ed., 2007, S. Chand Publications.
- Electricity and Magnetism, Brijlal and Subrahmanyam.
- Electricity and Magnetism, C. J. Smith.
- Principles of Electromagnetics, Matthew N. O. Sadiku, 2015, Oxford Univ. Press.
- Fundamentals of Electricity and Magnetism, D. N. Vasudeva.

B. Sc. Part I

PHYSICS

PAPER-III: WAVES, OSCILLATIONS AND ACOUSTICS

UNIT I: Wave Motion

Characteristics, Differential equation of wave motion, Transverse waves on a string. Travelling and standing waves on a string. Normal modes of a string, Group velocity and phase velocity. Plane waves, spherical waves. Wave intensity.

Fourier's theorem and its applications to square wave, saw tooth wave and triangular wave.

UNIT II: Simple Harmonic Motion:

Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Simple harmonic oscillations in mechanical and electrical systems.

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

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods, Lissajous Figures (1:1 and 1:2) and their uses.

UNIT III: Damped Harmonic Oscillations

Damped harmonic oscillations, Differential equation of damped harmonic oscillations and its solutions, power dissipation in damped harmonic oscillator, relaxation time and quality factor, Electrically damped harmonic oscillator (LCR circuit).

UNIT IV: Forced Harmonic Oscillations

Differential equation of Forced harmonic oscillations and its solutions, Forced harmonic oscillations in mechanical and electrical system, Transient and steady state behaviour, Resonance, Sharpness of resonance, Bandwidth, Energy dissipation, Quality factor of forced oscillator, Mechanical and electrical impedances.

UNIT V: Ultrasonics and Acoustics

Sound: Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale.

Ultrasonics: Generation of ultrasonic waves, their detection and applications, Piezo electric effect, quartz crystal.

Acoustics of buildings: Reverberation and time of reverberation, Absorption coefficient, Sabine's formula- measurement of reverberation time, Acoustic aspects of halls and auditoria.

Reference Books:

- Waves and Oscillations, Brijlal and Subrahmanyam, 2nd ed, 2018, Vikas Publishing House.
- The Physics of waves and oscillations, N. K. Bajaj, 2017, McGraw Hill Education.
- Acoustics Waves and Oscillations, S. K. Sen, 2nd ed. 1990, New Age Int. Pvt. Ltd.
- Waves and Oscillations, R. N. Chaudhuri, 2010, New Age Publishers.
- A Textbook of Oscillations, Waves and Oscillations, M. Ghosh, D. Bhattacharya, 2007, S. Chand Publications.

B. Sc. Part I
PHYSICS
PRACTICAL LIST
(Any Sixteen Experiments as per facilities in the Institution)

1. Measurements of length (or diameter) using vernier calipers, screw gauge, spherometer and travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Moment of Inertia of an irregular body by Inertia Table Flywheel.
4. To determine the Young's Modulus of a Wire by Bending of Beam Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Modulus of Rigidity of a Wire by Barton's Apparatus (Vertical Pattern).
7. To determine the Modulus of Rigidity of a Wire by Barton's Apparatus (Horizontal Pattern).
8. To determine g by Bar Pendulum.
9. To determine g by Kater's Pendulum
10. To determine the Elastic Constants of a Wire by Searle's method.
11. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g
12. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
13. To determine surface tension of liquid by Jaeger's method.
14. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
15. To compare capacitances using De' Sauty bridge.
16. To study the Characteristics of a Series RC Circuit.
17. To determine a Low Resistance by Carey Foster's Bridge.
18. Conversion of galvanometer into voltmeter.
19. Conversion of galvanometer into ammeter.
20. Comparison of two resistances by potentiometer.
21. Internal resistance by potentiometer.
22. Variation of magnetic field of coil and to find out radius of coil.
23. To verify Kirchoff's law.
24. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
25. To study the series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
26. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
27. To study damping effect of simple harmonic motion using simple pendulum.
28. To determine the frequency of AC main by sonometer.
29. To determine the frequency of AC main by Melde's method.
30. To study Lissajous Figures.

Reference Books:

- Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- Physics Practical: Gupta & Kumar, Pragati Prakashan
- Physics Practical: Goyal, Kedar Nath & Sons

B. Sc. Part II

PHYSICS

PAPER-I: THERMAL PHYSICS AND STATISTICAL MECHANICS

UNIT I: Thermodynamical concept and First Law of Thermodynamics:

Thermodynamic Description of system, Equilibrium and thermodynamic variables of a system, Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between C_P & C_V , Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient,

UNIT II: Second and Third Law of Thermodynamics:

Inadequacy of first law of thermodynamics, Reversible & irreversible processes, Principle of heat engine and refrigerator, Second law of thermodynamics & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

UNIT III: Thermodynamic Potentials:

Enthalpy, Gibbs free energy, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for $(C_P - C_V)$, C_P/C_V , TdS equations.

UNIT IV: Kinetic Theory of Gases:

Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

UNIT V: Theory of Radiation:

Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.

Reference Books:

- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B. N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F. W. Sears & G.L.Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Statistical Mechanics, Gupta Kumar, Pragati Prakashan.
- Statistical Mechanics, Satyaprakash, Kedar Nath Ram Nath and Sons.
- Statistical Mechanics, E. S. Rajgopal
- Statistical Physics, F. Rief, Mcgraw Hill.

B. Sc. Part II

PHYSICS

PAPER-II: OPTICS

UNIT I: Geometrical Optics:

Fermat's Principle: Principle of extremum path and its application to deduce laws of reflection and refraction, Applanic points of a sphere, Gauss's general theory of image formation: Coaxial symmetrical system, Cardinal points of an optical system, general relationship, thick lens and lens combinations, Lagrange equation of magnification, telescopic combinations, telephoto lens.

UNIT II: Optical Instruments:

Entrance and exit pupils, need for a multiple lens eyepiece, Ramsden's, Hygen's and Gaussiaqn eyepieces, Astronomical refracting telescope, Spectrometer, Aberrations in images: Chromatic aberrations, achromatic combination of lenses in contact and separated lenses, Monochromatic aberrations and their reduction: aspherical mirrors and Schmidt corrector plates, applanic points, oil immersion objectives meniscus lens.

UNIT III: Interference of Light:

The principle of superposition, two slit interference, coherence requirement for the sources, optical path retardations. Division of amplitude and division of wavefront, Fresnel's Biprism, Phase change on reflection: Stokes' treatment, Interference in Thin Films: parallel and wedge-shaped films, Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes), Newton's Rings: measurement of wavelength and refractive index. Michelson's Interferometer: Idea of formation of fringes and its application for determination of wavelength, Wavelength difference, Refractive index, Visibility of fringes. Fabry Perot interferometer.

UNIT IV: Diffraction of Light:

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

UNIT V: Polarization of Light

Transverse nature of light waves, Concept of Plane polarized light – production and analysis, Malus law, Brewster's law, Nicol prism, Circular and elliptical polarization, Double refraction. Optical rotation: Rotation of plane of polarization, origin of optical rotation in liquids and in crystals, polarimeter, half shade and biquartz.

Reference Books:

- Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
- Principles of Optics, B. K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H. R. Gulati and D.R. Khanna, 1991, R. Chand Publication
- A Textbook of Optics, N. Subramanyam and Brijlal.
- Optics and Atomic Physics, D. P. Khandelwal.
- Physical Optics, A. K. Ghatak.
- Optics, Eugene Hecht, Pearson Publishers.
- Optics, Satya Prakash.

B. Sc. Part II

PHYSICS

PAPER-III: SOLID STATE PHYSICS

UNIT I: Crystal Structure

Solids: Amorphous and Crystalline Materials, Lattice with a Basis – Central and Non-Central Elements, Bravais lattice and primitive vectors, Lattice Translation Vectors, Unit Cell (primitive, Wigner-Seitz cell and non-primitive), Seven crystal systems and Fourteen Bravais lattices, sc, bcc and closed packed structures (fcc, hcp and diamond structures), Sodium chloride, Cesium chloride and Zinc blende structures. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Atomic and Geometrical Factor.

UNIT II: Reciprocal Lattice

Reciprocal lattice: Definitions, examples and properties, Reciprocal lattice as Bravais lattice, Brillouin Zones, Reciprocal lattice of sc, bcc and fcc lattices, Lattice planes and Miller indices, X-Ray Diffraction, Bragg's law, Laue, powder and rotating crystal methods of X-ray diffraction, Introductory electron and neutron diffraction.

UNIT III: Elementary Lattice Dynamics

Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains, Acoustical and Optical Phonons, Qualitative Description of the Phonon Spectrum in Solids, Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids, T^3 law

UNIT IV: Free Electron Theory of Metals

The outstanding properties of metals, Outline and limitation of Lorentz- Drude Theory, Thermal conductivity, Electrical conductivity, Widemann- Franz relation, Sommerfeld theory of free electrons, Electrical conductivity and Ohms law, Electronic specific heat, Thermoionic emission, escape of electrons from metal, Failures of the free electron Model.

UNIT V Elementary band theory

Kronig Penny model, Band Gaps, Distinction between Conductors, Semiconductors and insulators, intrinsic and extensive semiconductors, P and N type Semiconductors, Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.

Reference Books:

- Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
- Elements of Solid-State Physics, J. P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
- Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
- Solid-state Physics, H. Ibach and H Luth, 2009, Springer
- Elementary Solid-State Physics, 1/e M. Ali Omar, 1999, Pearson India
- Solid State Physics, M.A. Wahab, 2011, Narosa Publications

B. Sc. Part II
PHYSICS PRACTICAL LIST

(Any Sixteen Experiments as per facilities in the Institution)

1. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
2. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine Stefan's Constant.
4. To verify Newton's Law of Cooling.
5. To determine J by Joule's calorimeter.
6. To verify the laws of probability distribution throwing one coin, two coin and ten coin.
7. To show that deviation of probability from theoretical value decreases with increase in number of events.
8. Study of statistical distribution from the given data and to find most probable, average and rms value.
9. Study of random decay of nuclear disintegration and determination of decay constant using dices.
10. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
11. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
12. To determine the Coefficient of Thermal Conductivity of rubber tube.
13. To determine the Coefficient of Thermal Conductivity of glass.
14. Measurement of Planck's constant using black body radiation.
15. Familiarization with Schuster's focussing; determination of angle of prism by Mercury Lamp.
16. To determine the Refractive Index of the Material of a given Prism using Mercury Light.
17. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
18. To determine wavelength of sodium light using Newton's Rings.
19. To determine the cardinal points of a combination of lenses using nodal slide arrangement.
20. To determine the resolving power of a telescope.
21. To determine specific rotation of cane sugar by polarimeter.
22. To determine refractive index of calcite prism.
23. To determine wavelength of Mercury light using plane diffraction Grating.
24. To investigate the motion of coupled oscillators.
25. To determine the value of Cauchy Constants of a material of a prism.
26. To determine the Resolving Power of a Prism.
27. To determine wavelength of sodium light using Fresnel Biprism.
28. To determine the wavelength of Laser light using Diffraction of Single Slit.
29. To determine wavelength of Sodium light using plane diffraction Grating.
30. To determine the Resolving Power of a Plane Diffraction Grating.

Reference Books:

- Advanced Practical Physics for students, B. L. Flint & H. T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal, 1985, Vani Publication

B. Sc. Part III

PHYSICS

PAPER-I: QUANTUM MECHANICS

UNIT I:

Origin of Quantum theory, Failure of Classical Physics to explain the phenomena such as Black body spectrum, Photoelectric effect, Characteristics and Einstein's explanation, Planck's quantum hypothesis, Planck's constant and light as a collection of photons; Compton scattering.

UNIT II:

De Broglie hypothesis of matter waves and De Broglie wavelength; Davisson-Germer experiment, Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle. Two slit interference experiment with photons, atoms and particles;

UNIT III:

Schrodinger's equation (Time independent and Time dependent), Postulates of Quantum Mechanics, Properties of Wave Function, Physical interpretation of Wave Function, Probability and probability current densities in three dimensions; Conditions for Physical acceptability of Wave Functions, Normalization, Eigenvalues and Eigenfunctions, Operator, position, momentum and Energy operators; Expectation values, Wave Function of a Free Particle.

UNIT IV:

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; Applications of Schrodinger's equation to particle in one dimensional box, Transmission across a potential barrier, Potential well of finite and infinite depths, Potential step, Quantum Mechanics of one dimensional simple harmonic oscillator-energy levels and energy eigenfunctions.

UNIT V:

Application of Schrodinger's equation to particle in three dimensional box, Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wavefunctions from Frobenius method; Orbital angular momentum quantum numbers l and m ; s, p, d,.. shells (idea only)

Reference Books:

- A Text book of Quantum Mechanics, P. M. Mathews & K. Venkatesan, 2nd Ed., 2010, McGraw Hill
- Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn., 2002, Wiley.
- Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
- Quantum Mechanics, G. Aruldas, 2ndEdn. 2002, PHI Learning of India.
- Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press

B. Sc. Part III

PHYSICS

PAPER-II: MODERN PHYSICS

UNIT I:

Thomson model, Rutherford model, Bohr model and spectra of hydrogen atoms, Shortcomings of these models, Bohr-Sommerfeld's model, Stern-Gerlach Experiment, Bohr magneton, Larmor's precession, Vector atom model, Spatial quantization and electron spin.

UNIT II:

Optical spectra and spectral notations, L-S and J-J coupling, selection rules and intensity rules, Explanation of fine structure of sodium D line, Normal Zeeman effect, X-ray spectra (Characteristic and continuous), Moseley's law.

UNIT III:

Absorption, spontaneous and stimulated emission processes, Metastable states, population inversion and pumping process, Einstein's A and B coefficients, Conditions of lasing action, Idea of Laser and Maser, Examples of Laser (Ruby Laser, He-Ne Laser, Semiconductor laser) and some applications of Lasers.

UNIT IV:

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle, Nature of nuclear force, Packing fraction and binding energy, NZ graph and semi-empirical mass formula, Liquid drop model and Shell Model.

UNIT V:

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life and half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ -ray emission.

Fission and Fusion: mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

Particle Detectors (Ionization Chamber, proportional and G. M. Counter)

Reference Books:

- Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill.
- Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A. Dubson, 2009, PHI Learning.
- Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill.
- Modern Physics, R. A. Serway, C. J. Moses, and C. A. Moyer, 2005, Cengage Learning.
- Modern Physics, Agrawal and Agrawal, Pragati Prakashan.
- Basic Nuclear Physics, B. N. Srivastava, Pragati Prakashan.
- Nuclear Physics, D. C. Tayal, Himalaya Publishing.
- Lasers and Non Linear Optics, B. B. Laud.

B. Sc. Part III

PHYSICS

PAPER-III: BASIC ELECTRONICS

UNIT I: Semiconductor Diodes

Intrinsic and extrinsic semiconductors, p and n type semiconductors, Semiconductor Diodes, Barrier Formation in PN Junction Diode, Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode, PN junction and its characteristics, Static and Dynamic Resistance, Zener diode, Principle and structure of Opto-electronic devices (1) LEDs (2) Photodiode (3) Solar Cell.

UNIT II: Power Supply

Half-wave Rectifiers, Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor, inductor filters, Clippers and clamping circuits, Voltage multiplier (Doublers and Triplers), Regulated Power supply, Zener Diode as a Voltage Regulator.

UNIT III: Transistor Amplifiers

Bipolar Junction transistors: n-p-n and p-n-p Transistors, Characteristics of CB, CE and CC Configurations, Current gains α and β , Relations between α and β , Load Line analysis of Transistors, DC Load line and Q-point, Active, Cutoff, and Saturation Regions, Transistor biasing circuits for CE Amplifier, Current, Voltage and Power Gains, Class A, B, and C Amplifiers, Field effect Transistor, UJT.

UNIT IV: Oscillators

Negative and positive feedback, Barkhausen's Criterion for Self-sustained Oscillations, Determination of Frequency (no mathematical derivation) of RC Oscillator (Wein bridge and phase-shift oscillator) and LC oscillator (Collector tuned and Colpitts oscillator), Crystal Oscillator, Multivibrator (Mono, astable and bistable)

UNIT V: Digital Circuits

Difference between Analog and Digital Circuits. Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates. De Morgan's Theorems, Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Fundamental Products, Minterms and Maxterms, Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. Binary Addition. Binary Subtraction using 2's Complement Method), Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor.

Reference Books:

- Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
- Electronic devices and circuits, S. Salivahanan and N.Suresh Kumar, 2012, Tata Mc-Graw Hill.
- Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning.
- Digital Principles & Applications, A. P. Malvino, D. P. Leach & Saha, 7th Ed.,2011, Tata McGraw Hill
- Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
- Principle of Electronics, V. K. Mehta.
- Hand Book of Electronics, Gupta and Kumar
- Basic electronics and linear circuits, N. N. Bhargava, D. C. Kulshrestha and S. C. Gupt

B. Sc. Part III

PHYSICS

PRACTICAL LIST

(Any Sixteen Experiments as per facilities in the Institution)

1. Frank-Hertz Experiment.
2. Determination of 'h' Planck's constant by Photoelectric effect.
3. Spectrum of Hydrogen and Rydberg constant.
4. Speed of light by Lecher's wires.
5. 'e/m' by Thomson method.
6. 'e/m' by Magnetron method.
7. 'e/m' by Helical method.
8. Measurement of Magnetic field strength.
9. Child Langmuir Law.
10. Identification and checking of electronic components; resistors, diodes, capacitor, transistors.
11. To verify truth table of AND, OR, NOT, NAND and XOR gates.
12. To verify De Morgan's Theorem.
13. To construct half adder and full adder.
14. To construct half subtractor and full subtractor.
15. To study I-V characteristics of p-n junction diode in forward and reverse bias.
16. To study I-V characteristics of Zener diode.
17. To study I-V characteristics of light emitting diode (LED).
18. To study half-wave rectifier with and without filter.
19. To study full-wave rectifier with and without filter.
20. To study p-n-p transistor in CE configuration.
21. To study n-p-n transistor in CE configuration.
22. To study JFET characteristics.
23. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
24. To design a Wien Bridge Oscillator.
25. Study of regulated power supply.
26. To study characteristics of photo cell.
27. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO to minimize a given logic circuit.
28. To determine energy band gap of a semiconductor.
29. To study MOSFET characteristics.
30. To study UJT characteristics.

Reference Books:

- Basic Electronics: A text lab manual, P. B. Zbar, A. P. Malvino, M. A. Miller, 1994, Mc-Graw Hill.
- Electronics: Fundamentals and Applications, J. D. Ryder, 2004, Prentice Hall.
- Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.