UNIVERSITY OF PUNE, PUNE.

Syllabus for F.Y.B.Sc

Subject: MATHEMATICS

(With effect from June 2013)

Introduction:

University of Pune has decided to change the syllabi of various faculties from June,2013. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects Board of studies in Mathematics with concern of teachers of Mathematics from different colleges affiliated to University of Pune has prepared the syllabus of F.Y.B.Sc. Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Aims:

i)Give the students a sufficient knowledge of fundamental principles ,methods and a clear perception of innumerous power of mathematical ideas and tools and know how to use them by modeling ,solving and interpreting.
ii) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.
iii)Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills , creative talent and power of communication necessary for various kinds of employment .
iv) Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

Objectives:

(i) A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays , state important facts resulting from their studies.

(ii) A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.

(iii) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.

(iv) A student be able to apply their skills and knowledge ,that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.

(v) A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.

Eligibility: 12th science with mathematics or equivalent examination.
Structure of the course:

Sr. No.	Paper	Theory	Oral	Internal	Total
1	MT 101 (Algebra and Geometry)	80 Marks	-	20 Marks	100 Marks
2	MT 102 (Calculus and Differential equations)	80 Marks	-	20 Marks	100 Marks
3	MT 103 (Mathematics Practicals)	72 Marks	08 Marks	20 Marks	100 Marks

All 3 above courses are compulsory.
Medium of Instruction: English
Examination:

A) Pattern of examination: Annual.
B) Standard of passing : 40 Marks out of 100 marks for each papers.
But for MT 101 and MT 102 for passing a student should obtain minimum 32 marks out of 80 in the theory examination and overall total marks for theory and internal should be minimum 40.
C)Pattern of question papers: For MT 101 and MT 102
Q1. Attempt any 08 out of 10 questions each of 02 marks. [16 Marks]
(05 questions from each term)
Q2. Attempt any 04 out of 06 questions each of 04 marks. [16 Marks].
(Based on term I)
Q.3. Attempt any 02 out of 03 questions each of 08 marks. [16 Marks].
(Based on term I)
Q4. Attempt any 04 out of 06 questions each of 04 marks. [16 Marks].
(Based on term II)
Q.5. Attempt any 02 out of 03 questions each of 08 marks. [16 Marks].
(Based on term II)
The pattern of question paper for MT 103 is given in the detailed syllabus.
D) External Students: Not allowed.
E)Verifation/Revaluation: Allowed for MT 101,MT 102.

Equivalence of Previous syllabus along with new syllabus:

Sr.No	New Courses	Old Courses
1	MT 101 (Algebra and Geometry)	Paper I (Algebra and Geometry)
2	MT 102 (Calculus and Differential equations)	Paper II (Calculus)
3	MT 103 (Mathematics Practicals)	Paper III (Mathematics Practicals)

Qualifications for Teacher: M.Sc. Mathematics (with NET /SET as per existing rules)

Details of Syllabus:

MT 101: Algebra &Geometry

FIRST TERM (Algebra)

Unit 01: Integers **15 Lectures**

1.1 Well Ordering Principle for N. Principle of Mathematical induction (strong form).

1.2 Divisibility in Z: Definition and elementary properties. Division Algorithm, Euclidean Algorithm (Without proof) G.C.D. and L.C.M of integers, Relatively prime integers, Definition Prime numbers ,Euclid's lemma, Basic properties of G.C.D., G.C.D of any two integers a and b if it exists is unique and can be expressed in the form $ax + by$, where $x, y \in \mathbb{Z}$.

1.3 Equivalence Relations, Equivalences classes, properties of Equivalences classes, Definition of partition, every partition gives an equivalence relation and vice-versa, Definition of Congruence, Congruence as equivalence relation on $\mathbb{Z}$, Residue classes, Partition of $\mathbb{Z}$, Addition modulo n , Multiplication modulo n.

Unit 02: Polynomials **6 Lectures**

2.1 Definition of polynomial, Degree of polynomial, Algebra of polynomials, Division algorithm (without proof). G.C.D of two polynomials (without proof).

2.2 Remainder Theorem, Factor Theorem.

2.3 Relation between the roots and the coefficients of a polynomial, Examples.

Unit 03: Matrices and System of linear equations. **15 Lectures**

3.1 Matrices, Echelon and Reduced echelon form of a matrix, Reduction of matrix to its echelon form, Definition of rank of a matrix by using echelon form.

3.2 System of linear equations, Matrix form of system of linear equations, Homogeneous and non-homogeneous system of linear equations, Gauss Elimination and Gauss Jordan Method.

3.3 Consistency of a system of linear equations, condition of consistency (without proof).

3.4 Eigen values, Eigen vectors, characteristic equation of a matrix of order up to 3×3

3.5 Statement of Cayley Hamilton theorem and its use to find the inverse of a matrix.

SECOND TERM (Geometry)

Unit 04: Analytical Geometry of two dimensions: 10 Lectures

4.1) Change of axes, Translation and rotation.

4.2) Conic Section: General equation of second degree in $x \; and \; y$. Centre of conic, Nature of conic, Reduction to standard form.

Unit 05: Planes in 3-dimension: 6 Lectures

Revision: Equations of the first degree in x, y, z, Transformation to the normal form, determination of plane under given conditions, Equations of the plane through three given points.

5.1 Systems of planes, two sides of a plane.

5.2 Length of the perpendicular from a point to a plane, bisectors of angles between two planes.

5.3 Joint equation of two planes, Angle between planes.

Unit 06: Lines in 3-dimension: 6 Lectures

Revision: Equations of a line, equations of a straight line in terms of its direction cosines and the co-ordinates of a point on it, equations of a line through two points, Symmetrical and unsymmetrical forms of the equations of a line. transformation of the equations of a line to the symmetrical form. Angle between a line and a plane.

6.1 The condition that a given line may lie in a given plane, the condition that two given lines are coplanar.

6.2 Number of arbitrary constants in the equations of a straight line, sets of conditions which determine a line.

6.3 The shortest distance between two lines, the length and equations of the line of shortest distance between two straight lines, length of perpendicular from a given point to a given line.

Unit 07: Sphere 8 Lectures

7.1 Definition and equation of the sphere in various forms.

7.2 Plane section of a sphere, intersection of two spheres.

7.3 Equation of a circle, sphere through a given circle, intersection of a sphere and a line.

7.4 Equation of a tangent plane.

Unit 08: Cones and Cylinders: **6 Lectures**

8.1 Definition of cone and cylinder.

8.2 Equation of cone and cylinder with vertex at origin and (α, β, γ).

8.3 The right circular cone, equation of a right circular cone.

8.4 The right circular cylinder, equation of a right circular cylinder.

Text Book: Text book of Algebra &Geometry, Prepared by B.O.S. in Mathematics, University of Pune, Pune.(2013).

Reference Books:

1. Shantinarayan: Analytical Solid Geometry, S. Chand and Company Ltd, New Delhi, 1998.
2. David Burton, Elementary Number Theory, Tata McGraw Hill, Indian Edition.
3. H. Anton and C. Rorres, Elementary Linear Algebra with Applications, Seventh Ed Wiley, (1994).
4. P.K.Jain and Khalil Ahmad,A Text Book of Analytical Geometry of Three Dimensions, Wiley Estern Ltd. 1999.
5. K.B.Datta, Matrix and Linear Algebra, Prentice hall of India Pvt.Ltd, New Delhi 2000.

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MT 102: Calculus and Differential Equations

FIRST TERM (Calculus)

Unit 1. The Real Numbers : **8 Lectures**

1.1 Algebraic properties of $\mathbb{R}$,

1.2 Order properties of $\mathbb{R}$, Iintervals in $\mathbb{R}$, neighborhoods and deleted neighborhoods of a real number, bounded subsets of $\mathbb{R}$.

1.3 The Completeness Property of $\mathbb{R}$, denseness of $\mathbb{Q}$ in $\mathbb{R}$.

Unit 2.Limit and Continuity **10Lectures**

2.1 $\epsilon - \delta$ definition of limit of a function, Basic properties of limits.

2.2 Continuity of function at a point, Types of discontinuity.

2.3 Continuous functions on intervals.

2.4 Properties of continuous functions on closed and bounded interval. (i) Boundedness. (ii) Attains its bounds. (iii) Intermediate value theorem

Unit 3. Differentiation **18Lectures**

3.1 Definition of derivative of a real valued function at a point, notion of differentiability, geometric interpretation of a derivative of a real valued function at a point.

3.2 Differentiability of a function over an interval.

3.3 Statement of rules of differentiability, chain rule of finding derivative of composite of differentiable functions (without proof), derivative of an inverse function.

3.4.Mean Value Theorems: Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem

3.5 Indeterminate forms. L-Hospitals rule.

3.6 Higher order derivatives, examples, Leibnitz Theorem and its applications

3.7 Taylor's and Maclaurin's Theorem with Lagrange's form of remainder (without proof),Examples with assuming convergence of series.

SECOND TERM
(Differential Equations)

Unit 4. Integration **08 Lectures**

4.1 Integration of rational function by using partial fraction.

4.2 Integration of some irrational functions:

$i)\int (ax+b)^{\frac{1}{n}}dx \text{ where } n \text{ is a positive integer},\ \ ii)\ \int \frac{Ax+B}{\sqrt{ax^2+bx+c}}dx$

$iii)\int (Ax+B)\sqrt{ax^2+bx+c}\ dx$

4.3 Reduction formula

$i)\int \frac{x^n}{\sqrt{ax^2+bx+c}}\ dx\ \ \ ii)\int \frac{dx}{(x^2+a^2)n}\ \ ,n \text{ is a positive integer}\ \ iii)\int (x^2+a^2)^{n/2}\ dx$

$iv)\int_0^{\pi/2} sin^n x dx\ \ \ v)\int_0^{\pi/2} cos^n x dx$

Unit 5. Differential Equations of first order and first degree: **16 Lectures**

5.1 Introduction to function of two, three variables, homogenous functions, Partial derivatives.

5.2 Differential equations, General solution of Differential equations.

5.3 Methods of finding solution of Differential equations of first order and first degree, Variable separable form, Homogenous Differential equations, Differential equations reducible to homogeneous form. Exact Differential equations. Differential equations reducible to exact Differential equations, Integrating factors, Linear Differential equations. Bernoulli's Differential equations.

Unit 6. Application of Differential Equations : 06 Lectures

6.1 Orthogonal trajectories.

6.2 Kirchhoff's law of electrical circuit (RC & LR Circuit)

Unit 7. Methods of finding general solution of Differential Equations of first order and higher degree: 06 Lectures

7.1 Equations solvable for p.

7.2 Equations solvable for x.

7.3 Equations solvable for y.

7.4 Equation in Clairaut's form.

Text Book: Text book of Calculus and Differential Equations**,** Prepared by B.O.S. in Mathematics,University of Pune, Pune.(2013).

Reference Books:

1. Introduction to Real Analysis by Robert G. Bartle and Donald R. Sherbert,

Third Edition, John Wiley and Sons, 2002

2. Integral Calculus, Shantinarayan, S.K.Mittal, S. Chand and Co. Publication 2006.

3. R.Courant and F.John, Introduction to Calculus and Analysis, Vol. 1, Reprint of the first

Ed., Sprinnger-Verlag,New York,1999.

4. Principles of Mathematical Analysis, W. Rudin, Third Edition, McGrawHill, 1976

5. Elementary Differential Equations, Macmillan Publication ,by Rainville and Bedient.

6. Ordinary and partial Differential equations,M.D. Raisingania, S. Chand and

Company,2009.

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MT 103: Mathematics Practical

(Practicals based on the applications of articles in MT 101 and MT 102)

List of Practicals:

TERM I

1. Integers.
2. Partition and residue class in $\mathbb{Z}$.
3. Polynomials.
4. Solution of system of linear equations.
5. Eigen values and Eigen vectors.
6. Miscellaneous.
7. Real numbers.
8. Limit and Continuity
9. Differentiation.
10. Application of differentiation
11. Integration..
12. Drawing graphs of elementary functions

TERM II

13. Changes of axes and conic section.
14. Planes in three dimensions.
15. Lines in three dimensions.
16. Sphere.
17. Cone and Cylinder.
18. Miscellaneous.
19. Preliminaries of differentials equation.
20. Solution of differential equation of first order and first degree-I
21. Solution of differential equation of first order and first degree-II
22. Application of differential equation.
23. Differential equation of first order and higher degree.
24. Miscellaneous.

Modalities For Conducting The Practical and The Practical Examination

1) There will be one 3 hour practical session for each batch of 15 students per week

2) A question bank consisting of 100 problems in all for the whole year, distributed in four Sections: 50 questions for each term (25 questions on MT 101 and 25 on MT 102) will be the course work for this paper. Question Bank will be prepared by the individual subject teacher and the problems included should be changed every year, based on the list of practicals given above. The question bank of each year should be preserved by the subject teachers, which can be reviewed by the L.I.C. members visiting college.

3) The College will conduct the Practical Examination at least 15 days before the commencement of the Main Theory Examination. The practical examination will consist of written examination of 72 marks and oral examination of 08 marks.

4) There will be no external examiner, the practical exam will be of the duration of 3 hours.

5) The subject teacher will set a question paper based on pattern as follows:

Q1. (a) Any 1 out of 2 worth 8 marks on MT101 (first term).
(b) Any 1 out of 2 worth 8 marks on MT 102. (first term).
Q2*. Any 5 out of 7 each of 4 marks on MT 101.
Q3*. Any 5 out of 7 each of 4 marks on MT 102..
Q4. (a) Any 1 out of 2 of 10 marks on MT 101(second term).
(b) Any 1 out of 2 worth 10 marks on MT 102 (second term).

(*In Q2 and Q3, there will be 3 questions from first term and 4 questions from the second term or vice-versa)

6) Each student will maintain a journal to be provided by the college.

7)The internal 20 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practicals.

8) It is recommended that concept may be illustrated using computer software and graphing calculators wherever possible.

9) The subject teachers can include computer practicals based on use of free mathematical software's like Sclib, Maxima, mu-pad, etc. for solving problems in the miscellaneous practical mentioned above.

10) Study tours may be arranged at places having important mathematical institutes or historical places.

11) **Special Instruction:** Before starting each practical necessary introduction, basic definitions, intuitive inspiring ideas and prerequisites must be discussed**.**

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Botany

(Faculty of Science & Technology)

F.Y.B.Sc. Botany

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: B. Sc Botany

1. Structure of Course:

Structure B.Sc. Botany syllabus					
Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Compulsory Course	BO 111	Plant life and utilization I	2
			BO 112	Plant morphology and Anatomy	2
			BO 113	Practical based on BO 111 & BO 112	1.5
	2	Compulsory Course	BO 121	Plant life and utilization II	2
			BO 122	Principles of plant science	2
			BO 123	Practical based on BO 121 & BO 122	1.5
2	3	Compulsory Course	BO 231	Botany Theory Paper 1	2
			BO 232	Botany Theory Paper 2	2
			BO 233	Botany Practical Paper	2
	4	Compulsory Course	BO 241	Botany Theory Paper 1	2
			BO 242	Botany Theory Paper 2	2
			BO 243	Botany Practical Paper	2
3	5	Discipline Specific Elective Course	BO 351	Botany Theory Paper 1	2
			BO 352	Botany Theory Paper 2	2
			BO 353	Botany Theory Paper 3	2
			BO 354	Botany Theory Paper 4	2
			BO 355	Botany Theory Paper 5	2
			BO 356	Botany Theory Paper 6	2
			BO 357	Botany Practical Paper 1	2
			BO 358	Botany Practical Paper 2	2
			BO 359	Botany Practical Paper 3	2
		Skill Enhancement course	BO 3510	Botany Theory Paper 7	2
			BO 3511	Botany Theory Paper 8	2
3	6	Discipline Specific Elective Course	BO 361	Botany Theory Paper 1	2
			BO 361	Botany Theory Paper 2	2
			BO 362	Botany Theory Paper 3	2
			BO 363	Botany Theory Paper 4	2
			BO 364	Botany Theory Paper 5	2
			BO 365	Botany Theory Paper 6	2
			BO 366	Botany Practical Paper 1	2
			BO 367	Botany Practical Paper 2	2
			BO 368	Botany Practical Paper 3	2
		Skill Enhancement course	BO 3610	Botany Theory Paper 7	2
			BO 3611	Botany Theory Paper 8	2

2. Equivalence of Previous Syllabus:

Old Course (2013 Pattern)	New Course (2019 CBCS Pattern)
Fundamentals of Botany: PAPER – I Term- I: Plant Diversity	BO 111 Plant life and utilization I
Botany Theory Paper II Term I – Industrial Botany	BO 112 Plant morphology and Anatomy
Fundamentals of Botany: PAPER - I Term- II: Morphology and Anatomy	BO 121 Plant life and utilization II
Botany Theory Paper II Term- II – Industrial Botany	BO 122 Principles of plant science
F. Y. B. Sc. Botany Practical Paper - III based on Theory Paper I and Paper II	BO 113 Practical based on BO 111 & BO 112 and BO 123 Practical based on BO 121 & BO 122

SEMESTER-I: PAPER-I

BO-111: PLANT LIFE AND UTILIZATION I (30 Lectures)

CREDIT-I **15 Lectures (15 Hours)**

1. INTRODUCTION **3 L**

General outline of plant kingdom (**Lower Cryptogams**: Thallophytes- Algae, Fungi & Lichens; **Higher Cryptogams**: Bryophytes and Pteridophytes; **Phanerogams**: Gymnosperms and Angiosperms- Dicotyledons and Monocotyledons). Distinguishing characters of these groups and mention few common examples from each.

2. ALGAE **9 L**

2.1: Introduction
2.2: General Characters
2.3: Classification (Bold and Wynne 1978) up to classes with reasons
2.4: Life Cycle of *Spirogyra* w.r.t. Habit, Habitat, Structure of thallus, structure of typical cell, Reproduction- Vegetative, Asexual and Sexual, systematic position with reasons
2.5: Utilization of Algae in Biofuel Industry, Agriculture, Pharmaceuticals, Food and Fodder

3. LICHENS **3 L**

3.1: Introduction
3.2: General Characters
3.3: Nature of Association, forms- Crustose, Foliose and Fruticose.
3.4: Utilization of lichens.

CREDIT-II **15 Lectures (15 Hours)**

4. FUNGI **9 L**

4.1: Introduction
4.2: General Characters
4.3: Classification (Ainsworth, 1973)
4.4: Life Cycle of Mushroom- *Agaricus bisporus* w.r.t. Habit, Habitat, Structure of thallus, Structure of Sporocarp, Structure of Gill, Reproduction- Asexual and sexual, Systematic position.
4.5: Utilization of Fungi in Industry, Agriculture, Food and Pharmaceuticals.

5. BRYOPHYTES **6 L**

5.1: Introduction
5.2: General Characters
5.3: Classification (G.M. Smith 1955)
5.4: Life Cycle of *Riccia* w.r.t. Habit, habitat, external and internal structure of thallus, Reproduction- vegetative, asexual and sexual- Structure of sex organs, fertilization, structure of mature sporophyte, structure of spore, systematic position with reasons.
5.5: Utilization: Bryophytes as ecological indicators, agriculture, fuel, industry and medicine.

(Development of sex organs not expected for all the above mentioned life cycles).

REFERENCES:

1. Ainswarth, Sussman and Sparrow (1973). The Fungi. Vol. IV-A and IV-B. Academic Press.
2. Bilgrami, K.S. and Saha, L.C. (1992) A Textbook of Algae. CBS Publishers and Distributors, Delhi.
3. Gangulee, Das and Dutta (2002). College Botany. Vol. I, New Central Book Agency (P) Ltd.
4. Dube, H.C. (1990). An Introduction to Fungi. Vikas Publishing House Pvt. Ltd., Delhi.
5. Krishnamurty, V. (2000). Algae of India and neighboring countries, Chlorophyta, Oxford and IBH, New Delhi.
6. Parihar, N.S. (1980). Bryophyta, An Introduction of Embryophyta. Vol. I. Central Book Distributors, Allahabad.
7. Puri, P. (1980). Bryophyta: Broad prospective. Atma Ram & Sons, Delhi.
8. Smith, G.M. (1971). Cryptogamic Botany. Vol. I: Algae & Fungi. Tata McGraw Hill Publishing Co., New Delhi.
9. Smith, G.M. (1971). Cryptogamic Botany. Vol. II: Bryophytes & Pteridophytes. Tata McGraw Hill Publishing Co., New Delhi.
10. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Algae, S. Chand Publication.
11. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Fungi, S. Chand Publication.
12. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Bryophytes, S. Chand Publication.

SEMESTER-I: PAPER-II

BO-112: PLANT MORPHOLOGY AND ANATOMY (30 Lectures)

CREDIT-I **15 Lectures (15 hours)**

1. MORPHOLOGY: 2 L

1.1: Introduction, definition, descriptive and interpretative morphology.
1.2: Importance in identification, nomenclature, classification, phylogeny and Plant breeding.

2. MORPHOLOGY OF REPRODUCTIVE PARTS:

2.1: INFLORESCENCE: 3 L

2.1.1 Introduction and definition
2.1.2 Types:
a) Racemose -Raceme, Spike, Spadix, Corymb, Umbel, Catkin and Capitulum.
b) Cymose -Solitary, Monochasial- Helicoid and scorpiod; Dichasial and Polychasial.
c) Special types -Verticillaster, Cyathium and Hypanthodium.
2.1.3 Significance

2.2: FLOWER: 7 L

2.2.1 Introduction and definition
2.2.2 Parts of a typical flower: Bract, Pedicel, Thalamus- forms, Perianth- Calyx and Corolla, Androecium and Gynoecium.
2.2.3 Symmetry: Actinomorphic and zygomorphic, Sexuality- Unisexual ands bisexual, Insertion of floral whorls on thalamus- Hypogyny, Epigyny and perigyny, Merous condition-Trimerous, tetrmerous and pentamerous.
2.2.4 Floral whorls:
a) **Calyx:** Nature- Polysepalous, Gamosepalous; Aestivation- types, Modifications of Calyx- Pappus, Petaloid and Spurred.
b) **Corolla:** Forms of Corolla-
i) Polypetalous- Cruciform and Papilionaceous.
ii) Gamopetalous- Infundibuliform, Bilabiate, Tubular and Campanulate.
iii) Aestivation- types and significance.
c) **Perianth:** Nature- Polytepalous, Gamotepalous.
d) **Androecium:** Structure of typical stamen, Variations- cohesion and adhesion.
e) **Gynoecium:** Structure of typical carpel, number, position, cohesion and adhesion; placentation- types and significance.

2.3: FRUITS: 3 L

2.3.1 Introduction and definition
2.3.2 Types of fruits:
a) **Simple:** Indehiscent - Achene, Cypsela, Nut and Caryopsis.
Dehiscent - Legume, Follicle and Capsule,
b) **Fleshy:** Drupe, Berry, Hespiridium and Pepo.
c) **Aggregate:** Etaerio of Berries and Etaerio of Follicles.
d) **Multiple fruits:** Syconus and Sorosis.

CREDIT- II **15 Lectures (15 Hours)**

3. ANATOMY: **2 L**

3.1 Introduction and definition

3.2 Importance in Taxonomy, Physiology, Ecological interpretations, Pharmacongnosy and Wood identification.

4. TYPES OF TISSUES: **8 L**

Outline with brief description, simple and complex tissues.

4.1: **Meristmatic tissues:** Meristem, characters and types based on origin, position and plane of division, functions.

4.2: **Permanent tissues:** Simple tissues - parenchyma, collenchymas, chlorenchyma and sclerenchyma.

4.3: **Complex/Vascular tissues:** Components of xylem and phloem, types of vascular bundles and functions.

4.4: **Epidermal tissues:** Epidermis, structure of typical stomata, trichomes, motor cells; functions.

5. INTERNAL ORGANIZATION OF PRIMARY PLANT BODY: **5 L**

5.1: Internal structure of dicotyledon and monocotyledon root.

5.2: Internal structure of dicotyledon and monocotyledon stem.

5.3: Internal structure of dicotyledon and monocotyledon leaf.

REFERENCES:

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5. Esau, K. (2006). Anatomy of seed plants. John Wiley and Sons, New York.
6. Fahn, A. (1974). Plant Anatomy. Pergamum Press Oxford.
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9. Naik, V.N. (1994). Taxonomy of Angiosperms. Tata McGraw Hill Publishing Comp., New Delhi.
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11. Pandey, B.P. (2009). A Text Book of Botany- Angiosperms. S. Chand and Co. Ltd. New Delhi.
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13. Saxena, A.K. and Sarabhai, R.P. (1968). A Text Book of Botany. Vol. III. Ratan Prakashan mandir, Agra.
14. Sharma, O.P. (1993). Plant Taxonomy. 2nd Edition, McGraw Hill Education, New Delhi.
15. Singh, Gurucharan (2005). Systematics- Theory and Practice. Oxford IBH.
16. Sutaria, R.N.A. Text Book of Systematic Botany.
17. Tayal, M.S. (2012). Plant Anatomy. Rastogi Publications.

BO 113: PRACTICALS BASED ON BO 111 & BO 112 (1.5 CREDITS)

1. Study of Life Cycle of *Spirogyra.* 1 P
2. Study of Life Cycle of *Agaricus.* 1 P
3. Study of Life Cycle of *Riccia* 1 P.
4. Study of forms of Lichens- Crustose, Foliose and fruticose. 1 P
5. Study of Mushroom Cultivation. 1 P
6. One day visit to study Algae, Fungi, Bryophytes and Lichens. 1 P
7. Study of Inflorescence. 2 P
   a. Racemose: Raceme, Spike, Spadix, Catkin, Corymb, Umbel and Capitulum
   b. Cymose: Solitary cyme, Uniparous cyme: helicoid and scorpiod, Biparous cyme and Multiparous cyme.
   c. Special type: Verticillaster, Hypanthodium and Cyathium.
8. Study of flower with respect to Calyx, Corolla and Perianth, Androecium and Gynoecium. 2 P
9. Study of fruits with suitable examples. 2 P
   a) Simple fruit: Dry: Achene, Cypsella and Legume; Fleshy: Berry and Drupe.
   b) Aggregate fruit: Etaerio of follicles and Etaerio of Berries.
   c) Multiple fruit: Syconus and Sorosis.
10. Study of internal primary structure of dicotyledonous root and stem e.g. Sunflower. 1 P
11. Study of internal primary structure of monocotyledonous root and stem e.g. Maize. 1 P
12. Study of internal primary structure of dicotyledonous and monocotyledonous leaf e.g. Sunflower and Maize. 1 P

SEMESTER-II: PAPER-I

BO-121: PLANT LIFE AND UTILIZATION-II (30 Lectures)

CREDIT-I **15 Lectures (15 hours)**

1. **INTRODUCTION:** Introduction to plant diversity- Pteridophytes, Gymnosperms and Angiosperms with reference to vascular plants. 3 L
2. **PTERIDOPHYTES:** General characters, Outline classification according to Sporne (1976) up to classes with reasons. Life cycle of *Nephrolepis* w.r.t. Habit, habitat, distribution, morphology, anatomy of stem and leaf, Reproduction – vegetative and sexual. 10 L
3. Utilization and economic importance of Pteridophytes. 2 L

CREDIT-II **15 Lectures (15 hours)**

1. **GYMNOSPERMS:** General characters, Outline classification according to Sporne (1977) up to classes with reasons. Life cycle of *Cycas* w.r.t. Habit, Habitat, Distribution, Morphology and Anatomy of Stem, leaf and reproductive organs- Male cone, Microsporophyll, microspores and megasporophyll, megaspore; structure of seed; Utilization and economic importance of gymnosperms. 8 L
2. **ANGIOSPERMS:** General characters, Outline of classification of Bentham and Hooker's system up to series, comparative account of monocotyledons and dicotyledons. 4L
3. Utilization and economic importance of Angiosperms: In food, fodder, fibers, horticulture and medicines. 3L

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SEMESTER-II: PAPER-II

BO-122: PRINCIPLES OF PLANT SCIENCE (30 Lectures)

CREDIT-1: PLANT PHYSIOLOGY AND CELL BIOLOGY

15 Lectures (15 Hours)

1. Introduction, definition and scope of plant physiology. 1 L
2. Diffusion – definition, importance of diffusion in plants, imbibition as a special type of diffusion. 1 L
3. Osmosis – definition, types of solutions (hypotonic, isotonic, hypertonic), endosmosis, exo-osmosis, osmotic pressure, turgor pressure, wall pressure, importance of osmosis in plants. 2 L
4. Plasmolysis – definition, mechanism and significance. 1 L
5. Plant growth - introduction, phases of growth, factors affecting growth, 2 L
6. Structure of plant cell, differences between prokaryotic and eukaryotic cell. 2 L
7. Plant cell wall – components of primary cell wall, structure and functions. 1 L
8. Ultrastructure and functions of chloroplast 2 L
9. Cell cycle in plants- importance of cell cycle in plants, divisional stages of mitosis and meiosis. 3 L

CREDIT-II: MOLECULAR BIOLOGY (15 Lectures) 15 Hours

1. Introduction and scope of molecular biology, central dogma of molecular biology. 2 L
2. Structure of DNA, nucleoside and nucleotide 2 L
3. Watson Crick model of DNA and its characteristic features, types of DNA (A, B and Z DNA). 3 L
4. Types of chromosomes. 2 L
5. Structure and types of RNA. 3 L
6. DNA replication- Types of replication (conservative, semi-conservative and dispersive), enzymes involved, leading and lagging strands, Okazaki fragments. 3 L

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14. Weaver, R. (2011). Molecular Biology. 5th Edition, Publisher- McGrew Hill Science. USA.

BO 123: PRACTICALS BASED ON BO 121 & BO 122 (1.5 CREDITS)

1. Study of life cycle of *Nephrolepis*. 1 P
2. Study of life cycle of *Cycas*. 1 P
3. Study of Bentham and Hooker's system of classification outline up to series with example 1 P
4. Study of comparative account of Dicotyledonous and Monocotyledonous plants w.r.t to external morphological characters. 1 P
5. Study of utilization and economic importance of Angiosperms- food, fodder, fibers, horticulture and medicines. 1 P
6. One day visit to study diversity of vegetation. 2 P
7. To observe characteristic features of prokaryotic and eukaryotic plant cell. 1 P
8. Staining of suitable nuclear material by Basic Fuchsin 1 P
9. Study of mitosis- preparation of slides using onion root tips to observe divisional stages. 1 P
10. Study of meiosis- preparation of slides using *Tradescantia/ Rhoeo/* Maize / Onion flower buds to observe divisional stages. 2 P
11. Estimation of chlorophyll-a and chlorophyll-b by using suitable plant material. 1 P
12. Plasmolysis- endosmosis, exosmosis, incipient plasmolysis using *Rhoeo* leaf peeling and Demonstration of Osmosis- curling experiment. 1 P
13. Study of DPD by using suitable plant sample 1 P

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Zoology

(Faculty of Science & Technology)

F.Y.B.Sc. Zoology

Choice Based Credit System Syllabus

to be implemented from

Academic Year 2019-2020

Preamble:

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. A zoology student needs to gain understanding of many areas of the subject to keep pace with advancements in Life Sciences.

This under-graduate degree program has been designed by the Board of Studies in Zoology of Savitribai Phule Pune University with a substantial component of what is needed from zoologists as a skilled career and what zoologists need to pursue for post-graduation and further academic studies. It follows the guidelines laid down by the University Grants Commission, New Delhi. This newly designed curriculum is a perfect blend of the classical aspects in Zoology and the advanced and more specialized areas.

This degree offers Discipline Specific Core Courses **[CC]** in Animal Systematics, Animal Ecology, Animal Cell biology, Applied Zoology, Pest Management, Histology, Biological Chemistry, Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Animal Physiology, Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology.

In addition to the Core Courses, Ability Enhancement Compulsory Courses **[AECC]** have been added in the second year i.e. Semester III and Semester IV of the undergraduate course. In the third year i.e. Semester V and Semester VI, Discipline specific Elective Courses **[DSEC]** and Skill Enhancement Courses **[SEC**] have been offered. The students, therefore, have an opportunity to take courses in Environment Awareness, Language communication: English/Marathi, Aquarium Management, Poultry Management and Environmental Impact Assessment. In Semester VI the students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspective of the subject as he progresses towards completion of the degree program. Field trips, Educational visits and the Project work have been included for the student to experience the applications of the theory learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciate: animal diversity, few applications of Zoology, the structure, functions and life processes at cellular, tissue, organ and system level, significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and field work through the practical course, field work and the project.

While presenting this new syllabus to the teachers and students of F.Y.B.Sc. Zoology, I am extremely happy to state that efforts have been made to seek inputs of all the stake holders to make it more relevant.

The new course that will be effective from the academic year 2019- 2020 and will follow the Choice Based Credit System in a Semester mode. It has been primed keeping in view the distinctive requirements of B.Sc. Zoology students. The contents have been drawn-up to accommodate the widening prospects of the discipline of Life Sciences. They reflect the changing prerequisites of the students. This program has been introduced with 132 credits for the subject group while 08 credits to earn from any of the 08 groups offering a range of curricular, cocuricular and extracurricular activities. This pattern has been specially aimed towards the overall development of the students'. The calculation of credits and CGPA will

be as per the guidelines of the University. The B.Sc. Zoology program provides an appropriate blend of classical and applied aspects of the subject. This newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills. The Syllabus has been revised with the following aims

- To foster curiosity in the students for Zoology
- To create awareness amongst students for the basic and applied areas of Zoology
- To orient students about the importance of abiotic and biotic factors of environment and their conservation.
- To provide an insight to the aspects of animal diversity.
- To inculcate good laboratory practices in students and to train them about proper
- handling of lab instruments.

1. Course Structure:

Course Structure with Credit Distribution of the Undergraduate Science Program in Zoology

Course	Course Code and Name of the Course		Credits
F.Y.B.Sc.	**SEMESTER I**	**SEMESTER II**	
CC	ZO-111 Animal Diversity I	ZO-121 Animal Diversity II	2+2
CC	ZO-112 Animal Ecology	ZO-122 Cell Biology	2+2
CC	ZO-113 Zoology Practical Paper	ZO-123 Zoology Practical Paper	1.5 +1.5
S.Y.B.Sc.	**SEMESTER III**	**SEMESTER IV**	
CC	ZO-231 Animal Diversity III	ZO-241 Animal Diversity IV	2+2
CC	ZO-232 Applied Zoology I	ZO-242 Applied Zoology II	2+2
CC	ZO-233 Zoology Practical Paper	ZO-243 Zoology Practical Paper	2+2
AECC	EVS 231-Environment Awareness	EVA 241-Environment Awareness	2+2
AECC	LA 231-English/Marathi	LA 241- English /Marathi	2+2
T.Y.B.Sc.	**SEMESTER V**	**SEMESTER VI**	
DSEC	ZO-351 Pest Management	ZO-361 Medical & Forensic Zoology	2+2
DSEC	ZO-352 Histology	ZO-362 Animal Physiology	2+2
DSEC	ZO-353 Biological Chemistry	ZO-363 Molecular Biology	2+2
DSEC	ZO-354 Genetics	ZO-364 Entomology	2+2
DSEC	ZO-355 Developmental Biology	ZO-365 Techniques in Biology	2+2
DSEC	ZO-356 Parasitology	ZO-366 Evolutionary Biology	2+2
DSEC	ZO-357 Zoology Practical Paper 1	ZO-367 Zoology Practical Paper 1	2+2
DSEC	ZO-358 Zoology Practical Paper 2	ZO-368 Zoology Practical Paper 2	2+2
DSEC	ZO-359 Zoology Practical Paper 3	ZO-369 Zoology Practical Paper 3	2+2
SEC	ZO-3510 Aquarium Management	ZO-3610 Environmental Impact Assessment	2+2
SEC	ZO- 3511 Poultry Management	ZO-3611 Project	2+2

Detailed Syllabus of F.Y.B.Sc.

Paper	Semester I Course Code & Course	Credits	No of Lectures	Marks (Internal + University)		SemesterII Course Code & Course	Credits	No of Lectures	Marks (Internal + University)
I	ZO-111 Animal Diversity I	02	30	15+ 35= 50		ZO-121 Animal Diversity II	02	30	15+ 35 = 50
II	ZO-112 Animal Ecology	02	30	15+ 35 = 50		ZO-122 Cell Biology	02	30	15+ 35 = 50
III	ZO-113 Zoology Practical Paper	01	15 practical	15+ 35 = 50		ZO-123 Zoology Practical Paper	01	15 Practical	15+ 35 = 50

Course No.	Course Title	Total Number of lectures/practical per Term	Standard of passing		
			Internal marks	**University marks**	**Total marks**
ZO-111 (First term)	Animal Diversity–I	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-121 (Second term)	Animal Diversity-II	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-112 (First term)	Animal Ecology	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-122 (Second Term)	Cell Biology	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-113 (First term)	Zoology Practical Paper	Practical session of 3 hours. 15 Practicals	15	35	50
ZO-123 (Second Term)	Zoology Practical Paper	Practical session of 3 hours. 15 Practicals	15	35	50

Animal Diversity I & II

Objectives:

1. To understand the Animal diversity around us.
2. To understand the underlying principles of classification of animals.
3. To understand the terminology needed in classification.
4. To understand the differences and similarities in the various aspects of classification.
5. To classify invertebrates and to be able to understand the possible group of the invertebrate observed in nature.to understand our role as a caretaker and promoter of life.

Learning outcomes for the course:

1. The student will be able to understand classify and identify the diversity of animals.
2. The student understands the importance of classification of animals and classifies them effectively using the six levels of classification.
3. The student knows his role in nature as a protector, preserver and promoter of life which he has achieved by learning, observing and understanding life.

Course Title: Animal Diversity –I

Course Code-ZO-111

Semester I **(2 credits-30 lectures)**

No.	Title & Contents	Number of lectures
1.	**Principles of Classification:**	**(05)**

Taxonomy & Systematics

1.1 Taxonomy: Basic terminology and Introuction

- Alpha, Beta and Gamma levels of taxonomy, Micro-taxonomy
- Macro taxonomy: Phenetics (numerical taxonomy, Cladistics (Phylogenetic systematics), Evolutionary taxonomy (evolutionary systematics)
- Classical taxonomy and experimental or neo taxonomy (biochemical taxonomy and Cytotaxonomy)
- Significance of Taxonomy

1.2 Systematics: definition introduction

1.3 Linnaean system of classification (Six level classification: Phylum, class, order, family, genus, species)

1.4 Concept of Species: Biological & Evolutionary

1.5 Introduction to Binomial Nomenclature.

1.6 Introduction to Five kingdom system.

2. **General Features of kingdom Animalia** **(02)**

2.1 General characters of Kingdom Animalia, Grades of organization

2.2 Symmetry.

3. **Kingdom Protista (Phylum: Protozoa)** **(07)**

3.1 Introduction to Phylum Protozoa

3.2 Salient features of Phylum Protozoa

3.3 Classification of Phylum Protozoa up to classes with two examples of each class (names only).

Class Rhizopoda (e.g :*Entamoeba histolytica, Arcella*),

Class Mastigophora (e.g: *Euglena viridis, Trypanosoma gambiense*),

Class Ciliata (e.g *Paramoecium caudatum, Opalina ranarum*),

Class Sporozoa (e.g *Plasmodium vivax, Toxoplasma gondii*)

3.4 Locomotion in Protozoa: Amoeboid, Ciliary and Flagellar with suitable examples

3.5 Type Study: ***Paramecium caudatum***: Classification, Habit and Habitat, External morphology, Feeding and digestion, Excretion, Reproduction (binary fission and conjugation)

3.6. Economic importance of Protozoa (three harmful and one useful protozoan)

3.6.1-**Harmful Protozoa**:

Plasmodium vivax (malarial parasite),

Entamoeba histolytica (Amoebic dysentery),

Trypanosoma gambiense (Gambian sleeping sickness).

3.6.2- **Useful Protozoa**:

Trichonympha

4. **Origin of Metazoa** **(01)**

4.1 Introduction Origin and importance of Metazoa

5. **Phylum Porifera** **(06)**

5.1. Introduction to Phylum Porifera

5.2 Classification of Phylum Porifera up to classes with two examples of each class (names only, no description of specimens).

Class Calcarea (e.g.: *Leucosolenia, Sycon (Scypha)*

Class Hexactinellida (e.g: *Euplectella* (venus flower basket), *Hyalonema* (glass sponge))

Class Demospongiae (e.g: *Chalina* (Mermaid's gloves, *Spongilla* (fresh water sponge))

5.3 Canal system in sponges: Ascon, Leucon and Rhagon type.

5.4 Skeleton in sponges: Spicules, its types:

Microscleres & Megascleres,

Monoaxon – monactinal, diactinal, Amphidiscs, Triaxon, Polyaxon,

Spongin fibres.

5.5 Regeneration in sponges.

5.6 Economic importance of Phylum Porifera.

6. **Phylum: Cnidaria** **(05)**

6.1 Introduction to Phylum Cnidaria

6.2 Salient features of Phylum Cnidaria

6.3 Classification of Phylum Cnidaria up to class level with given

examples each class (names of examples only)

Class Hydrozoa e.g.: Hydra, *Physalia* (Portuguese man of war)

Class Scyphozoa e.g: *Aurelia* (Jelly fish), *Leucernaria* (trumpet shaped Jellyfish)

Class Anthozoa: e.g; Metridium (Common sea anemone0

6.4 Polymorphism in Hydrozoa: Polyps & Medusa (polyp types: gastrozooids, dactylozooids, gonozooids) and functions

6.5 Economic importance of Cnidarians with reference to Corals and Coral reefs.

7. **Phylum Platyhelminthes** **(04)**

7.1 Introduction to Phylum Platyhelminthes

7.2 Salient features of Phylum Platyhelminthes

7.3 Classification of Phylum Platyhelminthes up to classes with two examples each class (names of examples only).

Class: Turbellaria (e.g: *Dugesia, Bipallium*)

Class: Trematoda (e.g*: Fasciola hepatica, Schistosoma haematobium*)

Class Cestoda: (*Taenia solium* (pork tape worm),*Echinococcus granulosus* (dog tapeworm)

7.4 Parasitic adaptations in Platyhelminthes: structural and physiological.

7.5 Economic importance of Platyhelminthes

Course Title: Animal Ecology

Course Code: ZO 112

Semester I **(2 Credits-30 Lectures)**

Learning outcomes for the course:

- The learners will be able to identify and critically evaluate their own beliefs, values and actions in relation to professional and societal standards of ethics and its impact on ecosystem and biosphere due to the dynamics in population.
- To understand anticipate, analyse and evaluate natural resource issues and act on a lifestyle that conserves nature.
- The Learner understands and appreciates the diversity of ecosystems and applies beyond the syllabi to understand the local lifestyle and problems of the community.
- The learner will be able to link the intricacies of food chains, food webs and link it with human life for its betterment and for non-exploitation of the biotic and abiotic components.
- The working in nature to save environment will help development of leadership skills to promote betterment of environment.

ZO 112: Animal Ecology **(2 Credits-30 Lectures)**

No.	Topic & Content	Number of lectures
1.	**Introduction to Ecology**	**(02)**
	1.1 Concepts of Ecology, Environment, Population, Community, Ecosystem, Biosphere, Autecology and synecology.	
2.	**Ecosystem**	**(08)**
	2.1 Types of ecosystems: Aquatic (Freshwater, estuarine, Marine and terrestrial (Forest, Grassland and Desert)	
	2.2 Structure and Composition of Ecosystem (Abiotic components and biotic components.	
	2.3 Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem, Ecological pyramids: Number, Biomass, and Energy.	
	2.4 concept of Eutrophication in lakes and rivers.	
3	**Population**	**(08)**
	3.1Characteristic of population: Density, Natality, Mortality, Fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion.	
	3.2Exponential and logistic growth,	
	3.3 Population regulation – density-dependent and independent factors.	
	Population interactions, Gause's Principle with laboratory and field interactions,	
	3.4 Quadrate, line and belt transect methods.	
4.	**Community**	**(07)**
	4.1Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Eco tone and edge effect; Ecological succession with one example.	
5.	**Animal interactions**	**(05)**
	5.1Introduction to Animal interactions	
	5.2 Types of Animal interactions with at least to suitable examples of each	
	5.2.1-Competition: Interspecific and intraspecific	

5.2.2- Beneficial Associations:

Commensalism (remora fish on shark, Cattle egrets on livestock),

Mutualism (Termite and *Trichonympha*, bees and flowers, cleaning symbiosis in fish by prawns.

5.3 Antagonistic associations: Parasitism (*Ascaris* and man, lice and humans), Prey predation (Lion and deer).

Course Title: Zoology Practical Paper

Course Code: ZO113

Semester I **(1.5 Credits-45 Hours)**

Animal Diversity –I

1. Museum Study of phylum Protozoa: Euglena, Paramecium, Amoeba, Plasmodium sp.
2. Museum study of Phylum Porifera: *Sycon*, *Euplectella*, *Chalina*, Spongilla.
3. Museum study of phylum Cnidaria: *Hydra*, *Physalia*, *Aurelia*, *Metridium*.
4 Museum Study of phylum Platyhelminthes: *Planeria*, *Faciola hepatica*, *Taenia solium*
5. Study of Paramecium: Culture, External morphology, Conjugation and Binary fission.
6. Study of permanent slides: Spicules and Gemmules in Sponges, T.S. of *Sycon*, T.S. of Hydra, Taeniasolium: Scolex, Gravid proglottid.
7. Identification of any three museum specimen with help of taxonomic identification key.
8. Visit to Zoological survey of India/ Museum/National Park.

Animal Ecology:

1. Estimation of Dissolved oxygen from given water sample.
2. Estimation of Water Alkalinity from given water sample.
3. Study of animal community structure by quadrate method (Field or Simulation).
4. Determination of density, frequency and abundance of species by quadrat method.
5. Study of microscopic fauna of freshwater ecosystem (from pond).
6. Estimation of water holding capacity of given soil sample.
7. Estimation of dissolved and free carbon dioxide from water sample.
8. Study of Eutrophication in lake/river.

Course Title: Animal Diversity –II

Course Code: ZO-121:

Semester II **(2 credits-30 lectures)**

No.	Title & Contents	Number of lectures
1.	**Phylum Aschelminthes**	**(04)**
	1.1 Introduction to phylum Aschelminthes 1.2 Salient features of Phylum Aschelminthes 1.3 Classification of Phylum Aschelminthes (Class Nematoda only with two examples – *Ascaris lumbricoides* (common round worm), *Wuchereria bancrofti* (Elephantiasis)). 1.4 Economic importance of class Nematoda.	
2.	**Phylum Annelida**	**(06)**
	2.1 Introduction to Phylum Annelida 2.2 Salient features of Phylum Annelida. 2.3 Classification of Phylum Annelida up to classes with examples of following classes (names of examples only). Class Polychaeta (e.g: *Nereis pelagica (neries/* sand worm, *Aphrodita aculeata* (=Aphrodite/ seamouse) Class Oligochaeta (e.g.: *Pheritima posthuma* (earthworm), Class Hirudinea (e.g: *Hirudinaria granulosa* common cattle leech) 2.4 Economic importance of Annelida with reference to earthworms as friends of farmers and in their role in vermicomposting.	
3.	**Phylum Arthropoda**	**(06)**
	3.1 Introduction to Phylum Arthropoda 3.2 Salient features of Phylum Arthropoda 3.3 Classification of Phylum Arthropoda with specific classes and mentioned examples (names only) Class:Crustacea*:Palaemon palaemon* (Prawn) *Brachyura* spp. crabs) Class: Chilopoda: *Scolopendra* sp. (centipede) Class: Diplopoda: *Julus* sp. (millipede)	

Class Insecta*: Periplaneta americana* (American Cockroach), *Anopheles stephensii* (mosquito).

Class: Arachnida- Spiders, *Buthus sp (*scorpion)

3.4 mouth parts in insects: Mandibulate (cockroach), Piercing and sucking (female Anopheles mosquito), chewing and lapping type (honey bee)

3.5 Economic importance of Arthropoda

Useful Insects: Honey bee, Lac insect, Silkworm.

Harmful insects: Female Anopheles mosquito, Red cotton bug, Rice weevil

4. **Phylum Mollusca** **(06)**

4.1 Introduction to Phylum Mollusca

4.2 Salient features of Phylum Mollusca

4.3 Classification of Phylum Mollusca with specific classes and mentioned examples (names only)

Class Gastropoda e.g *Pila globosa* (apple snail)

Class Pelecypoda e.g *Lamellidens marginalis*(Bivalve)

Class Polyplacophora e.g *Chiton*

Class: Cephalopodae.g: *Octopus vulgaris* (common octopus), *Sepia officinalis* (common Cuttle fish)

4.4 Economic importance of Mollusca.

5. **Study of Phylum Echinodermata** **(08)**

5.1 Introduction to Phylum Echinodermata

5.2 Salient features of Phylum Echinodermata.

5.3 Classification of Phylum Echinodermata with specific classes and mentioned examples (names only)

Class Asteroidea (*Asterias rubens* sea stars or starfish)

Class: Holothuroidea. *Holothuria sp*. sea cucumbers)

Class: Echinoidea *(Echinus esculentis* common sea urchins)

Class: Crinoidea (sea lilies or feather stars)

5.4 **Type study: *Asteriasrubens* (Sea Star):** Classification, Habit

Habitat, External Morphology, Digestive system, Water vascular

System and autotomy and regeneration

5.5 Pedicillaria in Echinodermata: straight, crossed, valvate, tridactylous, globigerous.

5.6 Economic importance of Echinidermata.

Course Title: Cell biology

Course Code: ZO122:

Semester II (2 credits-30 lectures)

Learning outcomes for Cell Biology

- The learner will understand the importance of cell as a structural and functional unit of life.
- The learner understands and compares between the prokaryotic and eukaryotic system and extrapolates the life to the aspect of development.
- The dynamism of bio membranes indicates the dynamism of life. Its working mechanism and precision are responsible for our performance in life.
- The cellular mechanisms and its functioning depends on endo-membranes and structures. They are best studied with microscopy.

ZO122: Cell biology (2 credits-30 lectures)

No. Title & Contents Number of lectures

1. **Introduction: (04)**

1.1 Introduction cell biology,

1.2 Cell as basic unit of life.

1.3 Importance of Cell Biology and its applications in industry.

Overview of Cells

1.3 Introduction to Prokaryotic and Eukaryotic cells.

1.4 Structure and function of Prokaryotic *(E. coli)*

1.5 Structure and function of Eukaryotic cells (Animal and Plant Cell)

2 **Techniques in Cell Biology:** **(04)**

3.1 Introduction

3.2 Microscopy: Basic Principle, Simple, Compound and applications of Electron Microscope.

3.3 Stains and dyes:
Types of Stain: Acidic, basic and neutral.

Dye (Preparation and chemistry of dyes not expected)

3.4 Micrometry.

3 **Plasma Membrane:** **(06)**

4.1Introduction

4.2 Structure of plasma membrane: Fluid mosaic model.

4.3Transport across membranes: Active and Passive transport, Facilitated transport, exocytosis, endocytosis, phagocytosis – vesicles and their importance in transport.

4.4 Other functions of Cell membrane in brief Protection, cell recognition, shape, storage, cell signalling.

4.5 Cell Junctions: Tight junctions, gap junctions, Desmosomes.

4 **Nucleus: Structure and function** **(04)**

5.1Introduction to Nucleus

5.2 Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleoplasm, Nucleolus

5.3 Chromatin: Eu-chromatin and Hetro-chromatin, nature and differences.

5.4 Functions of nucleus

5. **Endomembrane System** **(04)**

6.1 Introduction

6.2 Structure, location and Functions: Endoplasmic Reticulum, Golgi apparatus, Lysosomes and vacuoles.

7. **Mitochondria and Peroxisomes** **(03)**

7.1 Introduction

7.2 Mitochondria: ultrastructure and function of mitochondrion.

7.3 Peroxisomes

Cell Division **(05)**

7.1 Introduction

7.2 Cell cycle (G1, S, G2, M phases),

7.3 Mitosis.

7.4 Meiosis.

Course Title: Zoology Practical Paper

Course Code: ZO123

Semester II **(1.5 Credits-45 Hours)**

Animal Diversity –II

1. Museum study of Phylum Aschelminthes: *Ascaris lumbricoides*,
2. Museum study of phylum Annelida: *Neries*, Earthworm, Leech.
3. Museum study of phylum Arthropoda: Prawn, Cockroach, Centipede, Millipede, Crab
4. Museum study of phylum Mollusca: *Pila*, *Chiton*, Bivalve, Octopus.
5. Museum study of phylum Echinodermata: Sea Star, Sea urchin, Brittle Star, sea cucumber.
6. Study of permanent slides: Mouthparts of Insects -Mandibulate, Piercing and sucking, Chewing and Lapping.
7. Types of Shells in Mollusca. *Pila*, Bivalve, Chiton, Sepia.
8. Economic importance of honey bees, Lac insects silk worms, red cotton bug, Anopheles mosquito
9. Earthworm: vermicomposting bin preparation and maintenance.
10. Visit to a vermicomposting unit/ field for insect pest collection and its identification

Cell Biology

1. Study of Microscope: Simple and Compound
2. Micrometry: Measurement of microscopic objects
3. Study of cell: Preparation of temporary mount of human buccal epithelial cells.
4. Preparation of blood smears to observe the blood cells
5. Temporary preparation of mitotic cell from onion roots
6. Study of Cell organelles (any three) by using microphotographs

Recommended Reference Books

Animal Diversity – I and II

1. Anderson, D.T (Ed) 1988: Invertebrate Zoology, Oxford University Press.
2. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
4. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
5. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Brusca, R.C andBrusca, G. J (2003): Invertebrate (2^{nd} ed.) Sinauer Associates Inc., Publishers Sunderland.
7. Hadzi, J (1963): The Evolution of Metazoa, Macmillan Newyork.
8. Hyman, L. H (1940): Invertebrates Vol I, Protozoa through ctenophore.
9. Hyman. L. H (1955): The Invertebrates Vol: IV, Echinodermata, the coelomate bilateria, Mcgraw Hill, Newyork.
10. Modern Text-Book of zoology, Vertebrates. By Kotpal, RL., Rastogi and Co., Meerut.
11. Nigam H.C., Zoology of Chordates, Vishal Publication, Jalandhar-144008.
12. Phylum Protozoa to Echinodermata (series) by Kotpal, RL. Rastogi and Co., Meerut
13. Parker T.J and W.A Haswell (1972): A text book of Zoology, Vol –I (7^{th} edition by Marshall and Williams) Mcmillan Press ltd.
14. Jordan, E.L. and P.s.Verma Invertebrate Zoology, S. Chand and Co., Ltd. Ram Nagar, New Delhi.
15. Russel Hunter: - A Biology of higher invertebrates, MacMillon Co. Ltd. London

Animal Ecology

1. Colinvaux, P. A. (1993). Introduction to Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology: The Experimental Analysis of Distribution and Abundance, 6th Edition, ©2009, Pearson
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
6. Sharma P.D. (2002) Ecology and Environment, Himalaya Publication

Cell Biology

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI EditionJohn Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIIEdition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition.ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London
6. Inside the Cell (2005); US Department of Health Sciences, National Institute of Health, Natinal institute of General Medicine Sciences.
7. Lodish, H., D. Baltimore, A. Berk, L. Zipursky, M. Matsudaira and J. Darnell. (2010).
8. Molecular Cell Biology, Eds. 3, Scientific American & W. H. Freeman. New York.
9. Powar C B.: Cell Biology, Himalaya Publication, Meerut

Note: Latest editions of the recommended books may be referred.

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Chemistry

(Faculty of Science & Technology)

F.Y.B.Sc. Chemistry

Choice Based Credit System [CBCS] Syllabus

To be implemented from Academic Year 2019-2020

Structure of F. Y. B. Sc. Chemistry

Semester	Course	Discipline Specific Core Course (DSCC)*
I	Theory	CH-101 : Physical Chemistry (2 credit , 36 L)
	Theory	CH-102 : Organic Chemistry (2 credit, 36 L)
	Practical	CH-103 : Chemistry Practical –I (1.5 Credit, 46.8 L)
II	Theory	CH-201 :Inorganic Chemistry (2 credit , 36 L)
	Theory	CH-202 : Organic Chemistry (2 credit, 36 L)
	Practical	CH-203 : Chemistry Practical –II (1.5 Credit, 46.8 L)

***N.B.:**

i. **Each lecture (L) will be of 50 minutes.**
ii. **Each practical of 3h 15 min and 12 practicals per semester**
iii. **12 weeks for teaching 03 weeks for Continuous Assessments**

SavitribaiPhule Pune University, Pune

F.Y.B.Sc. Chemistry Syllabus

(CBCS Semester Pattern)

From Academic Year 2019-2020

Equivalence with Previous Syllabus

New Course (2019 Semester Pattern) (50 min /L)	**Old Course (2013 Annual Pattern) (48 min /L)**
CH-101 : Physical Chemistry (2 credit , 36 L) 50 Marks	Paper I : Physical and Inorganic Chemistry (72 L) 100 Marks
CH-201 :Inorganic Chemistry (2 credit , 36 L) 50 Mark	
CH-102 : Organic Chemistry (2 credit, 36 L) 50 Marks	Paper II : Organic and Inorganic Chemistry (72 L) 100 Marks
CH-202 : Organic Chemistry (2 credit, 36 L) 50 Marks	
CH-103 : Chemistry Practical–I (1.5 Credit, 46.8 L) 50 Marks	Paper III : Chemistry Practical 100 Marks
CH-203 : Chemistry Practical-II (1.5 Credit, 46.8L) 50 Marks	

Learning Objectives:

1. To understand basic concept of physical, organic and Inorganic chemistry.
2. To impart practical skills and learn basics behind experiments.
3. To prepare background for advanced and applied studies in chemistry.

SEMESTER-I

CH- 101: Physical Chemistry (2 Credits, 36 Lectures of 50 min.)

1. Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances, problems

(11 L)

2. Chemical Equilibrium:

Introduction: Free Energy and equilibrium - Concept, Definition and significance
The reaction Gibbs Energy, Exergonic and endergonic reaction. The perfect gas equilibrium, the general case of equilibrium, the relation between equilibrium constants, Molecular interpretation of equilibrium constant. The response of equilibria to conditions- response to pressure , response to temperature, Van't Haff equation, Value of K at different temperature, Problems

(11 L)

3. Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts– applications of solubility product principle.

(14 L)

Learning Outcome

1. Chemical Energetics

1. Students will be able to apply thermodynamic principles to physical and chemical process
2. Calculations of enthalpy , Bond energy, Bond dissociation energy , resonance energy
3. Variation of enthalpy with temperature –Kirchoff's equation
4. Third law of thermodynamic and its applications

2. Chemical Equilibrium

Knowledge of Chemical equilibrium will make students to understand

1. Relation between Free energy and equilibrium and factors affecting on equilibrium constant.
2. Exergonic and endergonic reaction
3. Gas equilibrium , equilibrium constant and molecular interpretation of equilibrium constant
4. Van't Haff equation and its application

3. Ionic equilibria

Ionic equilibria chapter will led students to understand

1. Concept to ionization process occurred in acids, bases and pH scale
2. Related concepts such as Common ion effect hydrolysis constant, ionic product, solubility product
3. Degree of hydrolysis and pH for different salts , buffer solutions

CH- 102: Organic Chemistry (2 Credits, 36 Lectures of 50 min.)

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **(9 L)**

Stereochemistry

Introduction, classification, Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Conformations with respect to ethane, butane and cyclohexane. Configuration: Geometrical - *cis* – *trans,* and E / Z Nomenclature (for upto two C=C systems). Optical isomerism Enantiomerism, Diastereomerism and Meso compounds). Concept of chirality (upto two carbon atoms).Threo and erythro; D and L; nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) **(14L)**

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Up to 5 Carbons) *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes:(Up to 5 Carbons)*Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalide *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$. **(13 L)**

Learning Outcome

1. The students are expected to understand the fundamentals, principles, and recent developments in the subject area.
2. It is expected to inspire and boost interest of the students towards chemistry as the main subject.
3. To familiarize with current and recent developments in Chemistry.
4. To create foundation for research and development in Chemistry.

Reference Books

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. Mc Murry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).
4. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
5. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
8. Marron and Prutton, Principal of Physical Chemistry
9. B S Bahl, G D Tuli, Arun Bahl , Essentials of Physical Chemistry
10. Peter Atkins and Julio de Paula , Elements of Physical Chemistry, Sixth edition (2013), Oxford press
11. Atkins' Physical Chemistry –Thermodynamics and Kinetics, 11th Edition , Oxford Press
12. Thomas Engel, Philip Reid; *Physical Chemistry* , Pearson Education (2006)
13. J. N. Gurtu, A. Gurtu; *Advanced Physical Chemistry,* Pragati Edition
14. Samuel H. Maron and Carl F. Prutton, *Principal of physical Chemistry*, 4th Edition, Collier Macmillan Ltd.

CH- 103: Chemistry Practical Course I

(1.5 Credits, 46.8 Lectures of 50 min.)

Section A:Chemical and Lab Safety (Compulsory)

1. Toxicity of the compounds used in chemistry laboratory.
2. Safety symbol on labels of pack of chemicals and its meaning
3. What is MSDS sheets? Find out MSDS sheets of at least hazardous chemicals ($K_2Cr_2O_7$, Benzene, cadmium nitrate, sodium metal, etc.)
4. Precautions in handling of hazardous substances like Conc. acids, ammonia, organic solvents, etc.

Section B: Physical Chemistry

a. Thermochemistry (Any three)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

b. Ionic equilibria (Two experiments)

1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

OR

1. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.
2. Preparation of buffer solutions **(Any One)**

(i) Sodium acetate-acetic acid and determine its buffer capacity

(ii) Ammonium chloride-ammonium hydroxide and determine its buffer capacity

Section C: Organic Chemistry(Five experiments)

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements) **(Three)**
2. Separation of constituents of mixtures by Chromatography: Measure the R_f value in each case(**Two)**
   (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
   (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Note: Combination of two compounds to be given

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbookof Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R.Chand& Co.: New Delhi (2011).
6. Prof. Robert H. Hill Jr., David C. Finster Laboratory Safety for Chemistry Students, 2nd Edition Wiley ISBN: 978-1-119-02766-9 May 2016
7. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version, ISBN 978-0-309-13864-2 | DOI 10.17226/12654, THE NATIONAL ACADEMIES PRESS Washington, D.C.

Learning Outcome

1. Importance of chemical safety and Lab safety while performing experiments in laboratory
2. Determination of thermochemical parameters and related concepts
3. Techniques of pH measurements
4. Preparation of buffer solutions
5. Elemental analysis of organic compounds (non instrumental)
6. Chromatographic Techniques for separation of constituents of mixtures

SEMESTER-II

CH-201: Inorganic Chemistry (2 Credits, 36 Lectures of 50 min.)

1. Atomic Structure

Origin of Quantum Mechanics: Why study quantum mechanics ?, Quantum mechanics arose out of interplay of experiments and Theory Energy quantization- i) Black body radiation ii) The photoelectric effect iii) Wave particle duality-a) The particle character of electromagnetic radiation b) the wave character of particle, iv) diffraction by double slit v) atomic spectra, Review of-Bohr's theory and its limitations, Heisenberg Uncertainty principle.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it, Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*).

(12 L)

2. Periodicity of Elements

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations

Long form of periodic table-s, p, d, and f block elements

Detailed discussion of following properties of elements with reference to s and p block

a) Effective nuclear charge , shielding or screening effect
b) Atomic and ionic radii
c) Crystal radii
d) Covalent radii
e) Ionization energies
f) Electronegativity , Pauling's / electronegativity scale
g) Oxidation states of elements

(09 L)

3. Chemical Bonding

Attainment of stable electronic configurations, Types of Chemical bonds: Ionic, covalent, coordinate and metallic bonds

Ionic Bond: General characteristics of ionic bonding, Types of ions, Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy,

Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bond: Valence Bond Approach, Hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. VSEPR theory, Assumptions, need of theory, application of theory to explain geometries of molecules such as i) ClF_3 ii) Cl_2O iii) BrF_5 iv) XeO_3 v) $XeOF_4$

(09 L)

4. Calculations used in Analytical Chemistry

Some important units of measurements-SI units, distinction between mass and weight, mole, millimole and Calculations

Solution and their concentrations- Molar concentrations, Molar analytical Concentrations, Molar equilibrium concentration, percent Concentration, part per million , part per billion , part per thousand, Solution –dilutant volume ration, functions , density and specific gravity of solutions, problems

Chemical Stoichiometry – Empirical and Molecular Formulas, Stoichiometric Calculations, Problems.

(06 L)

Learning Outcome

1. Atomic Structure

1. Various theories and principles applied to revel atomic structure
2. Origin of quantum mechanics and its need to understand structure of hydrogen atom
3. Schrodinger equation for hydrogen atom
4. Radial and angular part of hydrogenic wave functions
5. Significance of quantum numbers
6. Shapes of orbitals

2. Periodicity of Elements

1. Explain rules for filling electrons in various orbitals- Aufbau's principle, Pauli exclusion principle, Hund's rule of maximum multiplicity
2. Discuss electronic configuration of an atom and anomalous electronic configurations.
3. Describe stability of half-filled and completely filled orbitals.
4. Discuss concept of exchange energy and relative energies of atomic orbitals
5. Design Skeleton of long form of periodic table.
6. Describe Block, group, modern periodic law and periodicity.
7. Classification of elements as main group, transition and inner transition elements
8. Write name, symbol, electronic configuration, trends and properties.
9. Explain periodicity in the following properties in details:
    a. Effective nuclear charge, shielding or screening effect; some numerical problems.
    b. Atomic and ionic size.
    c. Crystal and covalent radii

d. Ionization energies
e. Electronegativity- definition, trend, Pauling electronegativity scale.
f. Oxidation state of elements

3. Chemical Bonding

1. Attainment of stable electronic configurations.
2. Define various types of chemical bonds- Ionic, covalent, coordinate and metallic bond
3. Explain characteristics of ionic bond, types of ions, energy consideration in ionic bonding, lattice and solvation energy and their importance in the context of stability and solubility of ionic compounds
4. Summarize Born-Lande equation and Born-Haber cycle,
5. Define Fajan's rule, bond moment, dipole moment and percent ionic character.
6. Describe VB approach, Hybridization with example of linear, trigonal, square planer, tetrahedral, TBP, and octahedral.
7. Discuss assumption and need of VSEPR theory.
8. Interpret concept of different types of valence shell electron pairs and their contribution in bonding.
9. Application of non-bonded lone pairs in shape of molecule
10. Basic understanding of geometry and effect of lone pairs with examples such as ClF_3, Cl_2O, BrF_5, XeO_3 and $XeOF_4$.

4. Calculations used in Analytical Chemistry

1. Calculations of mole, molar concentrations and various units of concentrations which will be helpful for preparation of solution
2. Relation between molecular formula and empirical formula
3. Stoichiometric calculation
4. Define term mole, millimole, molar concentration, molar equilibrium concentration and Percent Concentration.
5. SI units, distinction between mass and weight
6. Units such as parts per million, parts per billion, parts per thousand, solution-dilutant volume ratio, function density and specific gravity of solutions.

CH- 202: Organic Chemistry (2 Credits, 36 Lectures of 50 min.)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

1. Aromatic hydrocarbons

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions* (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

(07 L)

2. Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (S_N1, S_N2 and S_Ni) reactions. *Preparation:* from alkenes *and* alcohols. *Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. *Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

(12 L)

3. **Alcohols, Phenols and Ethers** (Upto 5 Carbons)

Alcohols: *Preparation:* Preparation of 1º, 2º and 3º alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions:* With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumen ehydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer- Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction.
Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

(12 L)

4. **Aldehydes and ketones (aliphatic and aromatic):** (Formaldehye, acetaldehyde, acetone and benzaldehyde)
Preparation: from acid chlorides and from nitriles.
Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemenson reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

(05 L)

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. &Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
6. Mc Murry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.

7. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, NewDelhi (1988).
8. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
9. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
10. Bahl, A. &Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
11. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
12. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
13. Kotz, J.C., Treichel P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
14. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
15. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York(1985).
16. Douglas A Skoog, Donald M West , F James Holler ,Stainly R Crounch , *Fundamentals of Analytical Chemistry*, 9th edition
17. *Atkins' Physical Chemistry,* 10th edition (2014), Oxford University Press
18. Thomas Engel, Philip Reid;*Physical Chemistry*, Pearson Education (2006)
19. J. N. Gurtu, A. Gurtu; *Advanced Physical Chemistry*, Pragati Edition

CH- 203: Chemistry Practical –II (1.5 Credits, 46.8 Lectures of 50 min.)

Section A: Inorganic Chemistry

I. Volumetric Analysis (Any Three)

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. To draw polar plots of s and p orbitals

II] Synthesis of commercially important inorganic compounds (any two)

1) Synthesis of potash alum from aluminum metal (scrap Aluminum metal)
2) Synthesis of Mohr's Salt $[(FeSO_4)\ (NH_4)_2SO_4]\bullet 6H_2O$
3) Preparation of Dark red inorganic pigment (Cu_2O)
4) Synthesis of $FeSO_4\bullet 7H_2O$

III] Analysis of commercial products (any one)

1) Estimation of Ca from calcium supplementary tablet by complexometric titration.
2) Estimation of acid neutralizing capacity of antacids like Gelusil tablet/ gellusil syrup etc.
3) Estimation of Cu (II) from brass alloy by iodometrically.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.

(Two Compounds)

1. Preparations: Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yields to be done.(**Any Two)**

a) Bromination of Cinnamic acid using sodium bromide and Sodium bromate.

(Green Chemistry Approach)

OR

a) Bromination of acetanilide using KBr and Cerric ammonium nitrate in aqueous medium.**(Green Chemistry Approach)**
b) Semicarbazone derivatives of aldehydes and ketones
c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

N. B.:

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. **Use optimum concentrations and volumes**
3. **Two burette method should be used for volumetric analysis (Homogeneous mixtures)**
4. **Use of microscale technique is recommended wherever possible**

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R.Chand & Co.: New Delhi (2011).

Learning Outcome

1. Inorganic Estimations using volumetric analysis
2. Synthesis of Inorganic compounds
3. Analysis of commercial products
4. Purification of organic compounds
5. Preparations and mechanism of reactions involved

Course Outcome

CH- 101: Physical Chemistry

After completing the course work learner will be acquired with knowledge of chemical energetics, Chemical equilibrium and ionic equilibria.

CH- 102: Organic Chemistry

Will learn Fundamentals of organic chemistry, stereochemistry (Conformations, configurations and nomenclatures) and functional group approach for aliphatic hydrocarbons

CH- 201: Inorganic Chemistry

Students will learn quantum mechanical approach to atomic structure, Periodicity of elements, various theories for chemical bonding and calculations used in analytical chemistry

CH-202: Organic Chemistry

Students will learn Functional group approach for the various reactions (preparations & reactions) in context to their structure

Lab Course CH 103 and CH-203

1. The practical course is in relevance to the theory courses to improve the Understanding of the concepts.
2. It would help in development of practical skills of the students.
3. Use of microscale techniques wherever required

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Physics

(Faculty of Science & Technology)

F.Y.B.Sc. (Physics)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: B.Sc. (Physics)

Preamble:

The curriculum for the B. Sc. (Physics) programme is designed to cater to the requirement of Choice Based Credit System following the University Grants Commission (UGC) guidelines. In the proposed structure, due consideration is given to Core and Elective Courses (Discipline specific - Physics), along with Ability Enhancement (Compulsory and Skill based) Courses. Furthermore, continuous assessment is an integral part of the CBCS, which will facilitate systematic and thorough learning towards better understanding of the subject. The systematic and planned curricula from first year to the third year (comprised of six semesters) shall motivate the student for pursuing higher studies in Physics and inculcate enough skills for becoming an entrepreneur.

Objectives:

- To foster scientific attitude, provide in-depth knowledge of scientific and technological concepts of Physics.
- To enrich knowledge through problem solving, minor/major projects, seminars, tutorials, review of research articles/papers, participation in scientific events, study visits, etc.
- To familiarize with recent scientific and technological developments.
- To create foundation for research and development in Physics.
- To help students to learn various experimental and computational tools thereby developing analytical abilities to address real world problems.
- To train studentsin skills related to research, education, industry, and market.
- To help students to build-up a progressive and successful career in Physics.

Structure of the Course:

Subject Name	Year	Semester	Course Type	Course Code	Course Name	Credit
Physics	1	I	Compulsory Course	PHY-111	Mechanics and Properties of Matter	2
				PHY-112	Physics Principles and Applications	2
				PHY-113	Physics Laboratory-IA	1.5
		II	Compulsory Course	PHY-121	Heat and Thermodynamics	2
				PHY-122	Electricity and Magnetism	2
				PHY-123	Physics Laboratory-IB	1.5
	2	III	Compulsory Course	PHY-231	Mathematical Methods in Physics I	2
				PHY-232	Electronics I /Instrumentation	2
				PHY-233	Physics Laboratory-2A	2
			Ability Enhancement Compulsory Course	PHY-2310	Environment -I	2
				PHY-2311	Language-I	2
		IV	Compulsory Course	PHY-241	Oscillations, Waves and Sound	2
				PHY-242	Optics	2
				PHY-243	Physics Laboratory-2B	2
			Ability Enhancement Compulsory Course	PHY-2410	Environment –II	2
				PHY-2411	Language-II	2
	3	V	Discipline Specific Elective Course	PHY- 351	Mathematical Methods in Physics II	2
				PHY- 352	Electrodynamics	2
				PHY- 353	Classical Mechanics	2
				PHY- 354	Atomic and Molecular Physics	2
				PHY- 355	Computational Physics	2
				PHY- 356	Elective I (Select any One)	2
				PHY- 357	Physics Laboratory-3A	2
				PHY- 358	Physics Laboratory-3B	2
				PHY- 359	Physics Laboratory-3C	2
			Skill Enhancement Course	PHY-3510	Maintenance and Repairing of Laboratory equipment – I	2
				PHY- 3511	Household Electrification, Maintenance and repairing - I	2

		VI	Discipline Specific Elective Course	PHY- 361	Solid State Physics	2
				PHY- 362	Quantum Mechanics	2
				PHY- 363	Thermodynamics and Statistical Physics	2
				PHY- 364	Nuclear Physics	2
				PHY- 365	Electronics II /Advanced Electronics	2
				PHY- 366	Elective II (Select any One)	2
				PHY- 367	Physics Laboratory-4A	2
				PHY- 368	Physics Laboratory-4B	2
				PHY- 369	Project	2
			Skill Enhancement Course	PHY-3610	Maintenance and Repairing of Laboratory Equipment – II	2
				PHY- 3611	Household Electrification, Maintenance and Repairing- II	2

SEMISTER-I

Course code and title: PHY-111 Mechanics and Properties of Matter

Lectures: 36 **(Credits-02)**

1. Motion: **(9 Lectures)**

Introduction to motion, Types of motion, Displacement, Velocity, Acceleration, Inertia, Newton's laws of motion with their explanations, Various types of forces in nature, Frames of reference (Inertial and Non inertial), Laws of motion and it's real life applications, Problems.

2. Work and Energy: **(7 Lectures)**

Kinetic energy, Work Energy Theorem, Work done with constant force, Work done with varying force (spring force), Conservative and Non conservative forces, Potential energy, Law of energy conservation, Gravitational potential energy, Problems.

3. Fluid Mechanics: **(8 Lectures)**

Concept of viscous force and viscosity, Coefficient of viscosity, Steady and Turbulent flow, Reynolds number, Equation of continuity, Bernoulli's Principle, Applications of Bernoulli's Principle (Ventury Meter, PitotTube), Applications of viscous fluids, Problems.

4. Properties of Matter: **(12 Lectures)**

Surface tension, Angle of contact, Factors affecting surface tension, Jaeger's method for determination of surface tension, Applications of surface tension.

Stress and Strain, Hook's law and Coefficient of elasticity, Young's modulus, Bulk modulus, Modulus of rigidity, Work done during longitudinal strain, Volume strain, Shearing strain, Poisson's ratio, Relation between three elastic moduli, (Y, η, K), Applications of elasticity, Problems.

Reference Books

1. Physics: Resnick, Halliday& Walker 9/e, Wiley.
2. University Physics : Sears and Zeemansky, XIth/XIIth Edition, Pearson Education.
3. Mechanics: D. S. Mathur, S. Chand and Company, New Delhi.
4. Elements of Properties of Matter : D. S. Mathur, S. Chand, New Delhi.
5. Concepts of Physics: H. C. Verma, BharatiBhavan Publisher.
6. Problems in Physics: P. K. Srivastava, Wiley Eastern Ltd.
7. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir VI Edition. Pearson Education/Prentice Hall International, New Delhi.
8. Fundamentals of Mechanics: J C Upadhyaya, Himalaya Publishing House.
9. Mechanics: D. S. Mathur, Revised by P. S. Hemne, S. Chand and Company, New Delhi.
10.

Course code and title: PHY-112 Physics Principles and Applications

Lectures: 36 **(Credits-02)**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1. To understand the general structure of atom, spectrum of hydrogen atom.
2. To understand the atomic excitation and LASER principles.
3. To understand the bonding mechanism and its different types.
4. To demonstrate an understanding of electromagnetic waves and its spectrum.
5. Understand the types and sources of electromagnetic waves and applications.
6. To demonstrate quantitative problem solving skills in all the topics covered.

1. Physics of Atoms **(08-Lectures)**

1.1 Introduction to Atom
1.2 Atomic Models:
- 1.2.1 Thomson's Atomic Model
- 1.2.2 Rutherford's Atomic Model
- 1.2.3 Bohr's Atomic Model

1.3 Atomic Spectra:
- 1.3.1 Emission line Spectrum
- 1.3.2 Absorption line spectrum
- 1.3.3 Uses of Atomic Spectra

1.4 Classical planetary model of Hydrogen Atom
1.5 The Bohr Theory of the Hydrogen Atom
1.6 The Hydrogen Spectrum
1.7 Frank-Hertz experiment
Problems

2. LASERS and Its Applications **(07-Lectures)**

2.1 Introduction to LASERS
2.2 Basic Principle of Lasers: Three Processes
2.3 Characteristics of Lasers: brief explanation
2.4 Boltzmann Distribution Law
2.5 Population Inversion and Pumping
2.6 Types of Lasers:
- 2.5.1 He-Ne Laser
- 2.5.2 Ruby Laser

2.7 Applications of Lasers
Problems

3. Physics of Molecules **(08-Lectures)**

3.1 Introduction to Bonding Mechanisms
3.2 Forces between Atoms
3.3 Types of Bonding:
- 3.3.1 Ionic Bonds
- 3.3.2 Covalent Bonds
- 3.3.3 van der Waal's Bonds
- 3.3.4 Hydrogen Bond
- 3.3.5 Metallic Bond

3.4 Rotation energy levels of a diatomic molecule
3.5 Vibration energy levels of a diatomic molecule
Problems

4. Sources of Electromagnetic Waves (06-Lectures)

4.1 Introduction to Electromagnetic Waves: Historical Perspective
4.2 General properties of Electromagnetic radiations
4.3 Electromagnetic spectrums and its sources
4.4 Production of electromagnetic waves: Hertz experiment
4.5 Plank's hypothesis of Photons
4.6 Applications of various waves in electromagnetic spectrum

5. Applications of Electromagnetic Waves (07-Lectures)

5.1 Microwave oven
5.2 RADAR
5.3 Pyroelectric thermometer
5.4 X-ray radiography
5.5 CT Scan
5.6 Solar cell and its types
Problems

Books/References

1. Concepts of Modern Physics: A Beiser (6th ed., McGraw Hill, 2003

2. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer

3. Sears and Zemansky's University Physics: H.D. Young R. A. Freedman, Sandin (11th Ed. Pearson Education)

4. LASERS: M. N. Avdhanulu, S. Chand Publications.

Course code and title: PHY-113 Physics Laboratory 1A

Practical: 10 (Credits-1.5)

Section I- Mechanics and Properties of Matter

Sr. No	Title of the experiment
1	Study and use of various measuring Instruments. 1. Vernier caliper 2. Micrometer Screw Gauge 3. Travelling Microscope
2	Study of Modulus of Rigidity of wire using Torsional Oscillations
3	Determination of coefficient of Viscosity by Poiseuille's method
4	Determination of "Y" and "η" by flat spiral spring
5	Determination of "Y" by bending method.
6	Study of surface tension by Jaeger's method
7	Study of Poisson's ratio of rubber using rubber tube /rubber chord
8	Study of surface tension of liquid using Fergusson Method

Section II-Physics Principles and Applications

Sr. No	Title of the experiment
1	Study of Spectrometer and determination of angle of prism
2	Study of Spectrometer calibration and determination of refractive indices of different colors
3	Study of divergence of LASER beam
4	Study of total internal reflection using LASER
5	Determination of Plank's constant
6	Determination of wavelength of LASER light by plane diffraction grating
7	Study of I-V characteristics of solar cell

Note: Any four experiments from each section be conducted during the semester, with a total of 10 experiments.

SEMISTER-II

Course code and title: PHY-121 Heat and Thermodynamics

Lectures: 36 **(Credits-02)**

1. Fundamentals of Thermodynamics **(10 Lectures)**

Concept of thermodynamic state, Equation of state, Van der Waal's equation of state, Thermal equilibrium, Zeroth law of thermodynamics, Thermodynamic processes: Adiabatic, Isothermal, Isobaric and Isochoric changes, Indicator diagram, Work done during isothermal change, Adiabatic relations, Work done during adiabatic change, Internal energy, Internal energy as state function, First law of thermodynamics, Reversible and Irreversible changes, Problems.

2. Applied Thermodynamics: **(9 Lectures)**

Conversion of heat into work and it's converse, Second law of thermodynamics, Concept of entropy, Temperature - entropy diagram, T-dS equations, Clausius - Clapeyron latent heat equations, Problems.

3. Heat Transfer Mechanisms **(9 Lectures)**

Carnot's cycle and Carnot's heat engine and its efficiency, Heat Engines: Otto cycle & its efficiency, Diesel cycle & its efficiency, Refrigerators: General principle and coefficient of performance of refrigerator, Simple structure of Vapour compression refrigerator, Air Conditioning: Principle and it's applications, Problems.

4. Thermometry: **(8 Lectures)**

Concept of heat & temperature, Principle of thermometry, Temperature scales & inter-conversions, Principle, Construction and Working: (Liquid thermometers, Liquid filled thermometers, Gas filled thermometers, Bimetallic thermometers, Platinum resistance thermometer, Thermocouple), Problems.

Reference Books:

1. Concept of Physics: H. C. Verma, BharatiBhavan Publisher.
2. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand and Company Ltd.
3. Heat and Thermodynamics: Mark W. Zemansky, Richard H. Dittman, 7th Edition, Mc-Graw Hill International Edition.
4. Thermodynamics and Statistical Physics: J. K. Sharma, K. K. Sarkar, Himalaya Publishing House.
5. Thermal Physics (Heat and Thermodynamics): A. B. Gupta, H. P. Roy books and Allied (P) Ltd. Calcutta.
6. Instrumentation:Devices & Systems, Rangan, Mani, and Sarma.

Course code and title: PHY-122 Electricity and Magnetism

Lectures: 36 **(Credits-02)**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1) To understand the concept of the electric force, electric field and electric potential for stationary charges.
2) Able to calculate electrostatic field and potential of charge distributions using Coulomb's law and Gauss's law.
3) To understand the dielectric phenomenon and effect of electric field on dielectric.
4) To Study magnetic field for steady currents using Biot-Savart and Ampere's Circuital laws.
5) To study magnetic materials and its properties.
6) Demonstrate quantitative problem solving skills in all the topics covered.

1. Electrostatics **(08-Lectures)**

1.1 Revision of Coulomb's law:
- 1.1.1 Statement
- 1.1.2 Variation of forces with distances

1.2 Superposition principle:
- 1.2.1 Statement
- 1.2.2 Explanation with illustration

1.3 Energy of system of charges
1.4 Concept of electric field
- 1.4.1 Due to point charge
- 1.4.2 Due to group charges

1.5 Concept of electric flex
1.6 Gauss's law in electrostatics
Problems

2. Dielectrics **(08-Lectures)**

2.1 Introduction to dielectric materials
2.2 Electric Dipole
- 2.2.1 Electric dipole
- 2.2.2 Dipole moment

2.3 Electric potential and intensity at any point due to dipole
2.4 Torque on a dipole placed in an electric field
2.5 Polar and non-polar molecules
2.6 Electric polarization of dielectric material
2.7 Gauss' law in dielectric
2.8 Electric vectors and its relation
Problems

3. Magnetization **(07-Lectures)**

3.1 Introduction to Magnetization
3.2 Magnetic materials
3.3 Types of Magnetic Materials
- 3.3.1 Diamagnetic materials
- 3.3.2 Paramgnetic materials
- 3.3.3 Ferromagnetic materials
- 3.3.4 Antiferromagnetic materials

3.4 Bohr magnetron
Problems

4. Magnetostatics (07-Lectures)

4.1 Introduction to magnetization,
4.2 Magnetic Induction and Intensity of magnetization
4.3 Biot-Savart's law:
- 4.3.1 Statement
- 4.3.2 Long straight conductor
- 4.3.3 Circular Coil

4.4 Ampere's circuital law:
- 4.4.1 Statement
- 4.4.2 Field of Solenoid
- 4.4.3 Field of Toroid

4.5 Gauss law for magnetism
Problems

5. Magnetic Properties of Materials (06-Lectures)

5.1 Definition
- 5.1.1 Magnetization (M),
- 5.1.2 Magnetic Intensity (H),
- 5.1.3 Magnetic Induction (B),
- 5.1.4 Magnetic Susceptibility
- 5.1.5 Magnetic Permeability

5.2 Relation between B, M and H
5.3 Hysteresis and Hysteresis Curve
5.4 Ferrite materials and its Applications
Problems

References:

1. Fundamentals of Physics: HallidayResnik and Walkar, 8th Edition.

2. Electromagnetics: B. B. Laud.

3. Foundations of Electromagnetic theory: Reitz,Milford, Christey.

4. Electricity and Electronics: D.C.Tayal, Himalaya Publishing House, Mumbai.

5. Introduction to Electrodynamics: D.G. Griffith.

6. Electricity and Magnetism: BrijLal, Subramanyan, RatanPrakashan (Revised edition, 1997).

7. Electricity and Magnetism: Khare, Shrivastav (Revised edition, 1997).

Course code and title: PHY-123 Physics Laboratory 1B

Practical: 08 **(Credits-1.5)**

Section I- Heat and Thermodynamics

Sr No	Title of the experiment
1	Interpretation of Isothermal and Adiabatic curve on P-V diagram and theoretical study of Carnot's cycle by drawing graphs of Isothermal and Adiabatic curves
2	Study of temperature coefficient of Thermistor.
3	Study of Thermocouple and determination of inversion temperature
4	Study of thermal conductivity by Lee's method
5	Study of specific heat of Graphite
6	Study of Solar constant
7	Determination of calorific values of different fuels

Section II- Electricity and Magnetism

Sr No	Title of the experiment
1	Study of charging and discharging of capacitor
2	Study of LR circuit
3	Study of LCR circuit
4	Study of Kirchhoff's Laws
5	Study of Diode characteristics
6	Study of Voltmeter, Ammeter and Multimeter (AC, DC, ranges and least count)
7	Determination of frequency of AC mains
8	Comparison of capacitor using DeSauty's method

Note: Any four experiments from each section be conducted during the semester.