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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2. Dutta, A.C. (2003). Botany for Degree students. Oxford University Press, New Delhi.
3. Eames, J. and Mc. Daniels (1994). An Introduction to Plant Anatomy. Tata McGraw Hill Publishing Comp., New Delhi.
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6. Fahn, A. (1974). Plant Anatomy. Pergamum Press Oxford.
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10. Pandey, B.P. (2007). Plant Anatomy. S. Chand and Co. Ltd. New Delhi.
11. Pandey, B.P. (2009). A Text Book of Botany- Angiosperms. S. Chand and Co. Ltd. New Delhi.
12. Radford, Albert E. (1986). Fundamentals of Plant Systematics. Publ. Harper and Row, New York.
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

REFERENCES:

1. Bendre, Ashok and Kumar, Ashok (1993). A Text Book of Practical Botany, Rastogy Publications, Meerut.
2. Chamberlain, C.J. (1934). Gymnosperms- Structure and Evolution. Chicago.
3. Coulter, J.M. and Chamberlain, C.J. (1917). Morphology of Gymnosperms. Chicago.
4. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperms taxonomy. Oliver and Boyd Publ. London.
5. Dutta, S.C. (1988). Systematic Botany. Wiley Eastern Ltd., New Delhi.
6. Eames, E.J. (1983). Morphology of Vascular Plants. Standard University Press.
7. Gangulee and Kar (2006). College Botany. New Central Book Agency (P.) Ltd. Kolkata.
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9. Parihar, N.S. (1976). Biology and Morphology of Pteridophytes. Central Book Depot.
10. Rashid, A. (1999). An Introduction to Pteridophyta. Vikas Publishing House Pvt. Ltd. New Delhi.
11. Sharma, O.P. (1990). Text Book of Pteridophyta. McMillan India Ltd. Delhi.
12. Singh, V. and Jain, D.K. (2010). Taxonomy of Angiosperms. Rastogy Publications, Meerut.

13. Singh, V., Pande, P.C., and Jain, D.K. (2011). A Text Book of Botany: Angiosperms. Rastogy Publications, Meerut.
14. Smith, G.M. (1955). Cryptogamic Botany Vol. II. McGraw Hill.
15. Sporne, K.R. (1986). The Morphology of Pteridophytes. Hutchinson University Library, London.
16. Sundar Rajan, S. (1999). Introduction to Pteridophyta. New Age International Publishers, New Delhi.
17. Vashishta, P.C., Sinha, A.R. and Kumar, Anil (2006). Gymnosperms. S. Chand and Comp. Ltd. New Delhi.
18. Vashista, B.R., Sinha A.K. and Kumar, A. (2008). Botany for degree students-Pteridophyta, S. Chand and Comp. Ltd. New Delhi.

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

REFERENCES:

1. Buchanan, B.B, Gruissem, W. and Jones, R.L (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists Maryland, USA.
2. Cooper, G.M. and Hausman, R.E. (2007). The Cell: Molecular Approach 4th Edition, Sinauer Associates, USA.
3. David, Nelson and Cox, Michael (2007). Lehninger Principles of Biochemistry. W.H. Freeman and Company. New York.
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8. Lincolin, Taiz and Eduardo, Zeiger (2010). Plant Physiology. 5th Edition. Sinauer Associates, Inc. Publishers. Sunder land, USA.
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10. Pal, J.K. and Ghaskadbi, Saroj (2009). Fundamentals of Molecular Biology. Oxford University Press. India.
11. Pandey, S.N. and Sinha, B.K. (2014). Plant Physiology. Vikas Publishing House Pvt. Ltd., India.
12. Salisbury, F.B. and Ross, C.B. (2005). Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont California, USA.
13. Watson, James D., Baker, Tania; Bell, Stephen P.; Alexander Gann; Levine, Michael and Lodwick, Richard (2008). Molecular Biology of the Gene. 6th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA.
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 Microbiology

(Faculty of Science & Technology)

F. Y. B. Sc. (Microbiology)

2019 Pattern

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

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

Preamble:

Microbiology is a broad discipline of biology which encompasses five groups of microorganisms i.e., bacteria, protozoa, algae, fungi, viruses. It studies their interaction with their environments as well as how these organisms are harnessed in human endeavour and their impact on society. The study has its extensions in various other conventional and advanced fields of biology by employing microbes as study models. Since inception of microbiology as a branch of science, it has remained an ever-expanding field of active research, broadly categorized as pure and applied science. Microorganisms were discovered over three fifty years ago and it is thought that a huge diversity yet remains to be explored.

Knowledge of different aspects of Microbiology has become crucial and indispensable to the society. Study of microbes has become an integral part of education and human progress. There is a continuous demand for microbiologists as work force – education, industry and research. Career opportunities for the graduate students are available in industry and research equally.

Introduction:

In the post globalization world higher education has to play a significant role in creation of skilled human resources for the well-being of humanity. The barriers among the academic fields seem to have dissolved. However, the disparities in the field of curriculum aspect, evaluation and mobility exist. With the changing scenario at local and global level, the syllabus restructuring should keep pace with developments in the education sector. Choice Based Credit System (CBCS) is being adopted and implemented to address the issues related to traditional system and it also aims to maintain the best of earlier curriculum. The student is at the centre of CBCS. The present curriculum focuses on students' needs, skill development, interdisciplinary approach to learning and enhancing employability.

Microbiology curricula are offered at two levels viz. undergraduate and postgraduate. The undergraduate curricula are prepared to impart basic knowledge of the respective subject from all possible angles. In addition, students are to be trained to apply this knowledge in day-to-day applications and to get a glimpse of research.

Objectives to be achieved:

- To enrich students' knowledge and train them in the pure microbial sciences
- To introduce the concepts of application and research in Microbiology
- To inculcate sense of scientific responsibilities and social and environment awareness
- To help students build-up a progressive and successful career

Course Structure:

- For First year: Student has to select 4 different subjects among the subjects offered by the College /Institute.
- For Second year: Student has to select 3 different subjects among 4 subjects chosen in first year.
- For Third year: Student has to select only 1 subject among the 3 subjects opted in second year.
- CGPA will be calculated based on core 132 credits only.
- Each theory credit is equivalent to 15 clock hours of teaching (12 hrs classroom+3 hrs of tutorials-active learning method) and each practical credit is equivalent to 30 clock hours of teaching in a semester.
- For the purpose of computation of workload, the following mechanism may be adopted as per UGC guidelines:
- Each theory Lecture time for FY, SY, TY is of 1 lecture = 50 min
- Each practical session time for FY is of 3-hour 15 min = 195 min
- Each practical session time for SY & TY is of 4-hour 20 min = 260 min

Eligibility for Admission:

First Year B.Sc.:

a. Higher Secondary School Certificate (10+2) or its equivalent Examination with English and Biology; and two of the science subjects such as Physics, Chemistry, Mathematics, Geography, Geology, etc.

OR

b. Three Years Diploma in Pharmacy Course of Board of Technical Education conducted by Government of Maharashtra or its equivalent.

OR

c. Higher Secondary School Certificate (10+2) Examination with English and vocational subject of + 2 level (MCVC) - Medical Lab. Technician (Subject Code = P1/P2/P3)

Admissions will be given as per the selection procedure / policies adopted by the respective college keeping in accordance with conditions laid down by the University of Pune.

Reservation and relaxation will be as per the Government rules.

Medium of Instruction: English

Award of Credits:

- Each course having 4 credits shall be evaluated out of 100 marks and student should

secure at least 40 marks to earn full credits of that course.

- Each course having 2 credits shall be evaluated out of 50 marks and student should

secure at least 20 marks to earn full credits of that course.

- GPA shall be calculated based on the marks obtained in the respective subject, provided that student should have obtained credits for that course.

Evaluation Pattern:

- Each course carrying 100 marks shall be evaluated with Continuous Assessment (CA) and University Evaluation (UE) mechanism.
- Continuous assessment shall be of 30 marks while University Evaluation shall be of 70 marks. To pass in a course, a student has to secure minimum 40 marks provided that he should secure minimum 28 marks in University Evaluation (UE).
- Each course carrying 50 marks shall be evaluated with Continuous Assessment (CA) and University Evaluation (UE) mechanism.
- Continuous assessment shall be of 15 marks while University Evaluation shall be of 35 marks.
- To pass in a course, a student has to secure minimum 20 marks provided that he/she should secure minimum14 marks in University Evaluation (UE).
- For Internal examination minimum two tests per paper of which one has to be a written test 10 marks
- Methods of assessment for Internal exams: Seminars, Viva-voce, Projects, Surveys, Field visits, Tutorials, Assignment, Group Discussion, etc (on approval of the head of the centre)

ATKT Rules:

- Minimum number of credits required to take admission to Second Year

of B. Sc.: 22

- Minimum number of credits required to take admission to Third Year of

B.Sc.: 44

1. In addition to the compulsory credits of 132, the student has to earn additional 8 credits from following groups by taking/participating/conducting respective activities.
2. Courses in Group-I are compulsory.
3. The student can earn maximum 04 credits from an individual group from Group 2 to Group-9. These extra credits will not be considered for GPA calculation; however, these are mandatory for the completion and award of B. Sc. Degree.

Group 1: Physical Education (at F. Y.B. Sc. Sem. I)-01 credit
Physical Education (at F. Y.B. Sc. Sem. II)-01credit (Note: Group I is compulsory for all the students as stated above.)

Group 2: Sport representation at Collegelevel-01 credit
Sport representation at University/Statelevel-02 credits

Group 3: National Social Service Scheme (participation in Camp): 01 credits
N.C.C. (with participation in annual camp)-01credit
N. C. C. (with B certificate/C certificate award)-02 credits
N.S.S./N.C.C. Republicdayparadeparticipation-04 credits

Group 4: Avishkar participation; Extension activity participation, Cultural activity participation–01 credit, Avishkar selection at University level-02 credits. Avishkar winner at state level-04credits

Group 5: Research paper presentation at State/National level-01 credits. Research paper presentation at international level-02 credits

Group 6: Participation in Summer school/programme; Short term course (not less than 1-week duration) -03 credit.

Group 7: Scientific Survey, Societal survey, -02 credits.

Group 8: Field Visits; Study Tours; Industrial Visits; Participation in curricular/ co curricular competitions -01 Credit.

Group 9: Online certificate Courses /MOOC Courses/ Career Advancement Course up to 04 credits (Minimum10 Hrs. / credit**)**

Completion of Degree Course:

- A student who earns 140 credits, shall be considered to have completed the requirements of the B. Sc. degree program and CGPA will be calculated for such student.

Titles of Papers and Scheme of Study Evaluation

F. Y. B.Sc. Microbiology

Semester	Paper Code	Paper	Paper title	Credits	Lectures/Week			Evaluation		
					Th.	Tut.	Pr.	CA	UE	Total
I	MB 111	I	Introduction to Microbial World	2	2			15	35	50
	MB 112	II	Basic Techniques in Microbiology	2	2			15	35	50
	MB113	III	Practical Course based on theory papers MB 111 and MB112	1.5			3	15	35	50
II	MB121	I	Bacterial Cell and Biochemistry	2	2			15	35	50
	MB122	II	Microbial cultivation and growth	2	2			15	35	50
	MB123	III	Practical Course based on theory papers MB121 and MB122	1.5			3	15	35	50

S. Y. B. Sc. Microbiology

Semester	Paper Code	Paper	Paper title	Credits	Lectures/Week			Evaluation		
					Th	Tut	Pr.	CA	UE	Total
III	MB 231	I	Medical Microbiology and Immunology	2	2			15	35	50
	MB 232	II	Bacterial Physiology and Fermentation	2	2			15	35	50
	MB 233	III	Practical Course based on theory papers MB 231 and MB 232	2			4	15	35	50
IV	MB 241	I	Bacterial Genetics	2	2			15	35	50
	MB 242	II	Air, Water and Soil Microbiology	2	2			15	35	50
	MB 243	III	Practical Course based on theory papers MB241 and MB 242	2			4	15	35	50

T. Y. B. Sc. Microbiology Proposed Structure
Semester V

Semester	Theory/ Practical / Skill Enhancement	Paper	Paper Title	Marks	Lecture
Sem V	Discipline Specific Elective Course Theory	MB 351 TC	Medical Microbiology- I	50	2 Credits /per TC
		MB 352 TC	Immunology- I	50	
		MB 353 TC	Enzymology	50	
		MB 354 TC	Genetics	50	
		MB 355 TC	Fermentation technology- I	50	
		MB 356 TC	Agricultural Microbiology	50	
	Discipline Specific Elective Course Practical	MB 357 PC	Practical Course I	50	2 Credits /per PC
		MB 358 PC	Practical Course II	50	
		MB 359 PC	Practical Course III	50	
	Skill Enhancement course	MB 3510	Marine microbiology	50	2 Credits
		MB 3511	Dairy Microbiology	50	2 Credits
Sem VI	Discipline Specific Elective Course Theory	MB 361 TC	Medical Microbiology- II	50	2 Credits /per TC
		MB 362 TC	Immunology- II	50	
		MB 363 TC	Metabolism	50	
		MB 364 TC	Molecular Biology II	50	
		MB 365 TC	Fermentation technology II	50	
		MB 366 TC	Food Microbiology	50	
	DisciplineSpecific Elective Course Practical	MB 367 PC	Practical Course I	50	2 Credits /per PC
		MB 368 PC	Practical Course II	50	
		MB 369 PC	Practical Course III	50	
	Skill Enhancement courses	MB 3610	Waste management	50	2 Credits
		MB 3611	Nanobiotechnology	50	2 Credits

Equivalence of Previous Syllabus: F. Y. B. Sc. Microbiology

Semester	Old Course (2013 Pattern)		New Course (2019 Pattern)	
	Course Number	Course title	Course Number	Course title
I	Theory Paper I	Introduction to Microbiology	MB 111	Introduction to Microbial World
	Theory Paper II	Basic Techniques in Microbiology	MB 112	Basic Techniques in Microbiology
	—	Practical Course (Term I & II)	MB 113	Practical Course based on theory paper I (MB 111) and Paper II (MB 112)
II	Theory Paper I	Introduction to Microbiology	MB 121	Bacterial Cell and Biochemistry
	Theory Paper II	Basic Techniques in Microbiology	MB 122	Microbial cultivation and growth
	—	Practical Course (Term I & II)	MB 123	Practical Course based on theory paper I (MB 121) and Paper II (MB 122)

External Students

There shall be no external students.

University Terms

Dates for commencement and conclusion for the first and second terms will be declared by the University authorities. Terms can be kept by only duly admitted students. The term shall be granted only on minimum 80 percent attendance at theory and practical course and satisfactory performance during the term.

Current curriculum orientation

To accommodate more advanced topics in the syllabi, it is necessary to understand the basic science knowledge level of the students that have chosen the Microbiology discipline. Curricula of courses of state and central boards of higher secondary level were reviewed to avoid reiterations of previous syllabi.

At **first year of under-graduation**, students will be provided the basic information that includes – characteristics of microbial world. The microorganisms will be studied for morphological, structural characterization, isolations techniques from natural and extreme

environments and their prominent features. The methodology to develop keen observation i.e., different microscopy techniques, staining techniques and nutritional requirements will be taught in detail, including these aspects at laboratory level as well. Introduction to biochemical characterization of components of micro-organism e.g., proteins, lipids, nucleic acids and carbohydrates and instrumental techniques to estimate these components qualitatively and quantitatively from micro-organisms or other natural sources will be the focus for second theory paper. Relevant experimentation on these topics will be included in practical course. In practical course, students will be trained in preparing laboratory manuals, standard operating practices and logbooks.

At **second year under-graduation** includes paper on principles of taxonomy and classification of major groups of microorganisms. The said paper will also include the physiological studies on these groups of micro-organisms. Second paper will deal with Air and Water Microbiology; role of micro-organisms in environment in regard to pollution and biodegradation; water and sewage treatment. Practical for the second-year students will be designed to be flexible incorporating project themes on environment, agriculture and pollution aspects to acquire laboratory skills. Practical at this level will also include application of biostatistics principles, computers for data analysis, interpretation, introduction to scientific writing and report preparation. These aspects can be better while carrying out the mini projects.

At **third year under-graduation**, the six theory papers will deal with broad areas of microbiology. Five such areas are – Medical microbiology, Microbial physiology, Microbial (prokaryotic and eukaryotic) genetics, Immunology and Fermentation technology. The sixth course will be Applied Microbiology that will include – Dairy Microbiology, Food Microbiology, Fermentation Technology, Agriculture Biotechnology, Fungal Biotechnology, etc. The practicals at third year will be planed more intensively, with exposure to applied fields and hands-on training.

Qualification of Teachers:

With minimum undergraduate and postgraduate degree in Microbiology (B. Sc. and M. Sc. Microbiology) and qualified as per UGC regulations.

Semester I
MB 111: Introduction to Microbial World

Credit	Topic	No. of Lectures (36)
Credit I	**1. Amazing world of Microbiology**	
	a. Development of microbiology as a discipline -Discovery of microscope and Microorganisms (Anton von Leeuwenhoek and Robert Hooke), Abiogenesis v/s biogenesis (Aristotle's notion about spontaneous generation, Francesco Redi's experiment, Louis Pasteur's & Tyndall's experiments)	**4**
	b. Golden Era of Microbiology	
	i. Contributions of - Louis Pasteur (Fermentation, Rabies, Pasteurization and Cholera vaccine-fowl cholera experiment) Robert Koch (Koch's Postulates, Germ theory of disease, Tuberculosis and Cholera-isolation and staining techniques of causative agent) Ferdinand Cohn (Endospore discovery)	**4**
	ii. Discovery of viruses (TMV and Bacteriophages), River's Postulates,Contribution of Joseph Lister (antiseptic surgery), Paul Ehrlich (Chemotherapy), Elie Metchnikoff (Phagocytosis), Edward Jenner (Vaccination) and Alexander Fleming (Penicillin) in establishment of fields of medical microbiology and immunology, Discovery of Streptomycin by Waksman	**4**
	iii. Contribution of Martinus W. Beijerinck (Enrichment culture technique, Rhizobium), Sergei N. Winogradsky (Nitrogen fixation and Chemo-lithotrophy) in the development of the field of soil microbiology	**2**
	c. Modern Era of Microbiology Carl Woese classification based on 16S r RNA Signification and Application of Human Microbiome, Nano-biotechnology and Space Microbiology	**2**
	d. Nobel laureates in Life Sciences of 21st Century (*Project Based Learning: Assignments should be given to student*)	**2**

Credit II	**2. Types of Microorganism and their differentiating characters**	
	a. Prokaryotes, Eukaryotes, three domain and five domain system of classification	**2**
	b. Bacteria (Eubacteria and Archaebacteria)	**1**
	c. Protozoa	**1**
	d. Fungi	**1**
	e. Algae	**1**
	f. Viruses, Viroids and Prions	**2**
	g. Actinomycetes	**1**
	3. Beneficial and Harmful effects of microorganisms:	
	a. Medical Microbiology (Enlist diseases caused by various microorganisms, vaccines and antibiotics)	**1**
	b. Environmental Microbiology (Eutrophication, red tide, Sewage treatment, bioremediation)	**2**
	c. Food and Dairy Microbiology (Food spoilage, food borne diseases, Probiotics and fermented food)	**1**
	d. Agriculture Microbiology (Plant diseases and Biofertilizers and Bio-control agents)	**1**
	e. Industrial Microbiology (Production of antibiotics, enzymes, solvents and contaminants-bacteria and phages)	**2**
	f. Immunology (Normal flora, Three lines of defence)	**2**

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Semester I

MB 112: Basic Techniques in Microbiology

Credit	Topic	No. of Lectures (36)
I	**1. Units of measurement – Introduction to Modern SI units**	**1**
	2. Microscopy	
	a. Bright field microscopy:	**3**
	• Electromagnetic spectrum of light	
	• Structure, working of and ray diagram of a compound light microscope; concepts of magnification, numerical aperture and resolving power.	
	• Types, ray diagram and functions of – condensers (Abbe and cardioid) eyepieces and objectives	
	• Concept of aberrations in lenses - spherical, chromatic, comma and astigmatism	
	b. Principle, working and ray diagram of	
	• Phase contrast microscope	**2**
	• Fluorescence Microscopy	**1**
	• Electron Microscopy – TEM, SEM	**3**

	3. Staining Techniques: **a.** Definition of Stain; Types of stains (Basic and Acidic), Properties and role of Fixatives, Mordants, Decolourisers and Accentuators **b.** Monochrome staining and Negative (Relief) staining **c.** Differential staining - Gram staining and Acid-fast staining **d.** Special staining- Capsule, Cell wall, Spore, Flagella, Lipid granules, metachromatic granules	**2** **1** **2** **3**
II	**4. Sterilization and Disinfection** **a. Sterilization** • Physical Agents - Heat, Radiation, Filtration • Checking of efficiency of sterilization (Dry and Moist) – Biological and Chemical Indicators **b. Disinfection:** • Chemical agents and their mode of action - Aldehydes, Halogens, Quaternary ammonium compounds, Phenol and phenolic compounds, • Heavy metals, Alcohol, Dyes, Detergents and Ethylene oxide. • Characteristics of an ideal disinfectant • Checking of efficiency of disinfectant - Phenol Coefficient (Rideal–Walker method)	**3** **4** **4** **4** **1** **2**

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F. Y. B. Sc. Microbiology Practicals Syllabus

Semester I Practical Course MB 113 (Implemented from 2019) Based on theory paper I (MB 111) and Paper II (MB 112)		
Expt. No.	**Topics**	**No. of Practicals**
1	a. Safety measures and Good Laboratory Practices in microbiology laboratory. b. Introduction, operation, precautions and use of common microbiology laboratory instruments: Incubator, Hot air oven, Autoclave, Colorimeter, Laminar air flow hood, Clinical centrifuge.	**2**
2	a. Construction (mechanical and optical), working and care of bright field microscope. b. Permanent slide observation: Algae, Fungi and Protozoa c. Wet mount slide preparation and its observation for: Bacteria, Algae, Fungi and Protozoa.	**3**
3	a. Introduction and use of common laboratory glass wares: Test tubes, culture tubes, suspension tubes, screw capped tubes, Petri plates, pipettes (Mohr and serological) micropipettes, Pasteur pipettes, Erlenmeyer flask, volumetric flask, glass spreader, Durham's tube, Cragie's tube and inoculating needles (wire loop, stab needles). b. Learning basic techniques in Microbiology: Wrapping of glassware, cotton plugging, cleaning and washing of glassware, biological waste disposal.	**2**
4	Basic staining techniques: a. Monochrome staining b. Negative staining c. Gram staining of bacteria	**3**
5	Observation of motility in bacteria using: Hanging drop method and swarming growth method.	**2**
6.	Checking of efficacy of chemical disinfectant: Phenol Coefficient by Rideal–Walker method.	**2**
	TOTAL	**14**

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Semester II
MB 121: Bacterial Cell and Biochemistry

Credits	Topic	No. of Lectures (36)
I	**1. Bacterial Cytology** Microbial cell size, shape and arrangements	**1**
	2. Structure, chemical composition and functions of the following components in bacterial cell:	
	a. Cell wall (Gram positive, Gram negative)	**2**
	b. Concept of Mycoplasma, Spheroplast, protoplast, L-form	**1**
	c. Cell membrane	**2**
	d. Endospore (spore formation and stages of sporulation)	**1**
	e. Capsule	**1**
	f. Flagella	**2**
	g. Fimbriae and Pili	**1**
	h. Ribosomes	**1**
	i. Chromosomal & extra-chromosomal material	**2**
	j. Cell inclusions (Gas vesicles, carboxysomes, PHB granules, metachromatic granules, glycogen bodies, starch granules, magnetosomes, sulfur granules, chlorosomes)	**4**
II	**3. Chemical Basis of Microbiology**	
	a. Atom, Biomolecules, types of bonds (covalent, co-ordinate bond, non-covalent) and linkages (ester, phospho-diester, peptide, glycosidic)	**2**
	b. Chemistry of Biomolecules: Structure, organization and functions	**1**
	4. Carbohydrates: Definition, classification	
	a. Monosaccharides: Classification based on aldehyde and ketone groups; structure of Ribose, Deoxyribose, Glucose, Galactose and Fructose.	**1**
	b. Disaccharides: Glyosidic bond, structure of lactose and sucrose.	**1**
	c. Polysaccharides: Structure and types Examples-Starch, glycogen, Peptidoglycan, chitin	**2**

	5. Lipids: Definition, classification **a.** Simple lipids – Triglycerides, Fats and oils, waxes. **b.** Compound lipids – Phospholipid, Glycolipids **c.** Derived lipids – Steroids, Cholesterol	**2**
	6. Proteins: Definition, classification **a.** General structure of amino acids, peptide bond. **b.** Types of amino acids based on R group **c.** Structural levels of proteins: primary, secondary, tertiary and quaternary **d.** Study of Hemoglobin, flagellin and cytoskeletal proteins	 **1** **1** **1** **1**
	7. Nucleic acids: Definition, classification **a.** DNA – structure and composition **b.** RNA – Types (m-RNA, t-RNA, r-RNA), structure and functions.	**2**
	8. Classification of Bacteria: Introduction to Bergey's Manual of Determinative and Systemic Bacteriology	**2**
	9. Classification of Viruses: ICTV nomenclature	**1**

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Semester II
MB 122: Microbial cultivation and growth

Credit	Topic	No. of Lectures (36)
I	**1. Cultivation of Microorganisms:**	
	a. Nutritional requirements and nutritional classification.	**3**
	b. Design and preparation of media: Common ingredients of media and types of media.	**3**
	c. Methods for cultivating photosynthetic, extremophilic and chemo-lithotrophic bacteria, anaerobic bacteria, algae, fungi, actinomycetes and viruses.	**4**
	d. Concept of Enrichment, Pure Culture, Isolation of culture by streak plate, pour plate, spread plate.	**3**
	e. Maintenance of bacterial and fungal cultures using different techniques.	**3**
	f. Culture collection centres and their role.	**1**
	g. Requirements and guidelines of National Biodiversity Authority for culture collection centres.	**1**
II	**2. Bacterial growth:**	
	a. Kinetics of bacterial growth (Exponential growth model)	**3**
	b. Growth curve and Generation time	**2**
	c. Diauxic growth	**1**
	d. Measurement of bacterial growth- Methods of enumeration:	**4**
	e. Microscopic methods (Direct microscopic count, counting cells using improved Neubauer, Petroff-Hausser's chamber)	
	f. Plate counts (Total viable count)	**1**

	g. Turbidometric methods (including Nephelometry)	**1**
	h. Estimation of biomass (Dry mass, Packed cell volume)	**1**
	i. Chemical methods (Cell carbon and nitrogen estimation)	**1**
	j. Factors affecting bacterial growth [pH, Temperature, Solute Concentration (Salt and Sugar)] and Heavy metals.	**4**

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Semester II Practical Course MB 123 based on theory paper I (MB 121) and Paper II (MB 122)		
Expt. No.	**Topics**	**No. of Practicals**
1	**i.** Preparation of simple laboratory nutrient media (Nutrient agar/broth, MacConkey's agar). **ii.** Checking sterilization efficiency of autoclave using a biological indicator (*B. stearothermophilus*) **iii.** Preparation of Winogradsky's column and observation of different types of microorganisms using bright field microscope.	1 1 1
2	**Special staining techniques:** **i.** Endospore staining **ii.** Capsule staining	2
3	**Isolation of bacteria:** Streak plate technique (Colony and cultural characteristics)	1
4	**Enumeration of bacteria from fermented food / soil / water by:** **i.** Spread plate method **ii.** Pour plate method	2
5	**Study of normal flora of skin:** **i.** Cultivating and observing different morpho-forms of bacteria from skin. **ii.** Study of effect of washing on skin with soap and disinfectant on it's microflora.	2
6	**To study the effect of different parameters on growth of *E. coli*:** **i.** pH, temperature, sodium chloride concentration **ii.** Study of oligodynamic action of heavy metal	3
7	**Preservation of cultures on:** Slants, soil and on grain surfaces; revival of these cultures and lyophilized cultures.	1
	TOTAL	**14**

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7. Kumar V. (2012). Laboratory Manual of Microbiology. India: Scientific Publishers.
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Links: https://microbiologysociety.org/static/uploaded/23cbf9c5-f8c8-4f91-b092a4ad819e6357.pdf

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Mathematics

(Faculty of Science & Technology)

F.Y.B.Sc. (Mathematics)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: B. Sc (Mathematics)

Preamble:

SavitribaiPhule Pune University has decided to change the syllabi of various faculties from June,2019. 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 SavitribaiPhule Pune University 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 clearperception of innumerous power of mathematical ideas and tools and know how to usethem 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 and technology.
(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 interestingand 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.

Course Outcome:

Upon successful completion of this course, the student will be able to:
i) The mathematical maturity of students in their current and future courses shall develop.
ii) The student develops theoretical, applied and computational skills.
iii) The student gains confidence in proving theorems and solving problems.

Structure of the course:

	Semester - I		Semester -II		Credit
Paper I	**MT-111**	**Algebra**	**MT-121**	**Analytical Geometry**	**2**
Paper II	**MT-112**	**Calculus - I**	**MT-122**	**Calculus - II**	**2**
Paper III	**MT-113**	**Mathematics Practical**	**MT-123**	**Mathematics Practical**	**1.5**

Proposed Structure of S. Y. B. Sc. Mathematics Courses:

	Semester - III		Semester -IV		
Paper I	**MT-231**	**Calculus of Several Variables**	**MT-241**	**Linear Algebra-I**	**2**
Paper II	**MT-232 (A)**	**Laplace Transform and Fourier Series**	**MT-242(A)**	**Vector Calculus**	**2**
	MT-232 (B)	**Computational Geometry**	**MT-242(B)**	**Numerical Analysis**	**2**
Paper III	**MT-233**	**Mathematics Practical**	**MT-243**	**Mathematics Practical**	**2**

Proposed Structure of T. Y. B. Sc. Mathematics Courses:

Semester- V		Semester- VI		Credit
MT 351	**Matric Spaces**	**MT 361**	**Complex Analysis**	**2**
MT 352	**Real Analysis-I**	**MT 362**	**Real Analysis-II**	**2**
MT 353	**Problem Course on MT 351 and MT 352**	**MT 363**	**Problem Course on MT 361 and MT 362**	**2**
MT 354	**Group Theory-I**	**MT 364**	**Ring Theory-I**	**2**
MT 355	**OrdinaryDifferential Equations–I**	**MT 365**	**Partial Differential Equations-I**	**2**
MT 356	**Problem Course on MT 354 and MT 355**	**MT 366**	**Problem Course on MT 364 and MT 365**	**2**

Select Any Two out of six courses				
MT357:A	**Operations Research**	**MT367: A**	**Optimization Techniques**	**2**
MT357:B	**Number Theory**	**MT367: B**	**Graph theory**	**2**
MT357:C	**C- Programming**	**MT367: C**	**Lebesgue Integration**	**2**
MT357:D	**Lattice Theory**	**MT367: D**	**Financial Mathematics**	**2**
MT357:E	**Python Course -I**	**MT367: E**	**Python Course-II**	**2**
MT357:F	**Machine Learning Course- I**	**MT367: F**	**Machine Learning Course- II**	**2**
MT 338	**Practical based on papers selected from 357 A to 357 F**	**MT 348**	**Practical based on papers selected from 367 A to 367 F**	**2**
MT-3510	**Skill Enhancement course in maths**	**MT-3511**	**Skill Enhancement course in maths**	**2**
MT-3610	**Skill Enhancement course in maths**	**MT-3611**	**Skill Enhancement course in maths**	**2**

All three above courses are compulsory.

1. **Equivalence of Previous syllabus along with new syllabus:**

	Old course	New Course
Paper I	**MT-101 : Algebra and Geometry**	**MT-111: Algebra and MT-121 : Analytical Geometry**
Paper II	**MT-102 : Calculus and Differential Equations**	**MT-112 : Calculus - I and MT-122 : Calculus – II**
Paper III	**MT-103 : Mathematics Practical**	**MT – 113 : Mathematics Practical and MT – 113 : Mathematics Practical**

Details of Syllabus:

Semester – I

MT 111- Algebra

Unit 1: Sets Relations and Functions (8 Lectures)

1.1 Sets, Relations, Equivalence relations, Equivalence classes and partitions of a set

1.2 Functions, Basic terminology, Types of Functions, Inverse of a Function, Composition of Functions (Excluding theorems only examples).

Unit2: Divisibility Theory in the Integers(10 Lectures)

2.1 Mathematical Induction:Well-Ordering Principle.

2.2 The Division Algorithm, The Greatest Common Divisor, Euclid's Lemma, The Least Common Multiple, The Euclidean Algorithm.

Unit 3: Primes and the theory of Congruence (8 Lectures)

3.1 The Fundamental Number of Arithmetic: Prime Numbers, Euclid's Lemma.

3.2 The theory of Congruence: Basic Properties of congruence.

3.3 Fermat's Theorem

Unit 4: Complex Numbers (10 Lectures)

4.1 Sums and Products, Basic Algebraic Properties, Moduli, Complex Conjugates, Exponential form, Products and Quotients, De-Moivre's theorem.

4.2 Roots of Complex Numbers: The n^{th} roots of unity.

4.3 Regions in Complex Plane.

Text Books:

1. **A Foundation Course in Mathematics, Ajit Kumar, S. Kumeresan and Bhaba Kumar Sarma, Narosa Publication House.**
   Unit 1: Chapter 2: Sec. 2.1 to 2.5, Chapter 3: Sec. 3.1 to 3.6, Chapter 4: Sec. 4.1 to 4.4.
2. **Elementary Number Theory, David M. Burton, Tata McGraw Hill, Sixth Edition.**
   Unit 2: Textbook 2: Chapter 1: Sec. 1.1, Chapter 2: Sec. 2.2 to 2.4
   Unit 3: Textbook 2: Chapter 3: Sec. 3.1, Chapter 4: Sec. 4.1, 4.2, Chapter 5: Sec. 5.2.
3. **Complex Variables and Applications, James Ward Brown and Ruel V. Churchill, Mc-Graw Hill, Seventh Edition.**

Unit 4: Textbook 3: Chapter 1: Sec 1 to 10.

Reference Books:

1. Textbook of Algebra, S. K. Shah and S. C. Garg, Vikas Publishing House Pvt. Ltd. Edition 2017.
2. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert,John Wiley and Sons Inc, Fourth Edition.

MT 112: CALCULUS - I

Unit 1: Real Numbers (06 Lectures)

1.1 The Algebriac and Order Properties of R:
Algebraic properties of R, Order properties of R, Well-Ordering Property of N. Arithmetic mean-Geometric mean inequality, Bernoulli's inequality.
(Revision: essential properties should be revised with illustrative examples)

1.2 Absolute Value and the Real Line:
Absolute value function and its properties, triangle inequality and its consequences, neighborhood of a point on real line.

1.3 The Completeness Property of R:
Definitions of Upper bound, Lower bound, supremum, infimum of subsets of R, completeness property of R.

1.4 Applications of the Supremum Property:
Archimedean property and its consequences, The density theorem (without proof).

Unit 2. Sequences (10 Lectures)

2.1 Sequences and Their Limits:
Definition and examples of sequences of real numbers, Definition of limit of sequence and uniqueness of limit, Examples on limit of sequence.

2.2 Limits Theorems:
Definition of bounded sequence, Every convergent sequence is bounded, Algebra of limits.

2.3 Monotone Sequences:
Definition and examples of monotone sequences, Monotone convergence theorem and examples.

2.4 Subsequences and Bolzano -Wierstrass Theorem:
Definition of subsequence and examples, Divergence criteria, Monotone Subsequence theorem (without proof), Bolzano -Wierstrass theorem (first proof).

Unit 3. Limits (08 lectures)

3.1 Functions and their Graphs:

Functions, domain and range, graphs of functions, representing a function numerically, Vertical line test, Piecewise defined functions, increasing and decreasing functions, even and odd functions symmetry, common functions

3.2 Limits of Functions:

Definition of cluster point and examples, definition of limit of a function, sequential criterion for limits, divergence criteria.

3.3 Limit Theorems:

Algebra of limits (proofs using sequential criterion) ,Squeeze theoerem.

3.4 Some extension of limit concepts:

one-sided limits, infinite limits (without proof) .

Unit 4: Continuity (12 lectures)

4.1 Continuous Functions:

Definition of continuous function at a point , sequential criterion for continuity, Divergence criterion, combination of continuous functions.

4.2 Continuous Functions on Intervals:

Properties of continuous functions on an interval, Boundedness theorem (without proof), The minimum -maximum theorem(without proof), Location of root theorem (Without proof), Bolzano's intermediate value theorem. Continuous function maps closed bounded interval to closed bounded interval, Preservation of interval theorem.

Textbook Books:

1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.

Unit 1: Chapter 2: Sec 2.1 (2.1.1 to 2.1.13), Sec. 2.2(2.2.1 to 2.2.9), 2.3, 2.4(2.4.1, 2.4.3 to 2.4.6, 2.4.8, 2.4.9).

Unit 2: Chapter 3: Sec. 3.1(3.1.1 to 3.1.7, 3.1.10, 3.1.11), Sec. 3.2(3.2.1 to 3.2.11), Sec. 3.3(3.3.1, 3.3.4), Sec. 3.4 (3.4.1 to 3.4.3, 3.4.5 to 3.4.8).

Unit 3: Chapter 4: Sec. 4.1(4.1.1, 4.1.3 to 4.1.9), Sec. 4.2(4.2.1 to 4.2.8), Sec. 4.3 (4.3.1 to 4.3.9).

Unit 4: Chapter 5: Sec. 5.1, Sec. 5.2, Sec 5.3 (5.3.1 to 5.3.5, 5.3.7 to 5.3.10).

2. Thomas Calculus, Thirteenth edition, Pearson Publication.

Unit 3: Text book-2: Chapter 1: Sec. 1.1.

Reference books:

1 Introduction to Real analysis, William F.Trench, Free edition, 2010.
2 Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.
3 Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.
4 Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Surgent, Addison Wesley, tenth edition.

MT 113: Mathematics Practical

(Practicals based on the applications of articles in MT 111 and MT 112)
In Semester-I, we should conduct 3 written practical and 3 practical on maxima software for each paper MT-111 and MT-112.

List of Practical

Practical 1 : Problems on Unit 1 and Unit 2(Written) from MT-111.
Practical 2 : Problems on Unit 3 (Written) from MT-111.
Practical 3 : Problems on Unit 4(Written) from MT-111.
Practical 4 :Introduction to maxima software forMT-111.
Practical 5 : Problems on unit 1 and unit 2 from MT-111using maxima software.
Practical 6 : Problems on Unit 3 and Unit 4 from MT-111using maxima software.
Practical 7: Problems on Unit 1 and Unit 2(Written) from MT-112.
Practical 8 : Problems on Unit 3 (Written) from MT-112.
Practical 9 : Problems on Unit 4(Written) from MT-112.
Practical 10 :Introduction to maxima software for MT-112.
Practical 11 : Problems on unit 1 and unit 2 from MT-112using maxima software.
Practical 12 : Problems on Unit 3 and Unit 4 from MT-112 using maxima software.

Note:

1 The soft copy of practicals on maxima software will be prepared and provided by the Board of Studies in mathematics.

2. Practicals on maxima software can be performed on computer and android mobiles.

3. Android mobiles are allowed for practical examination on maxima software .

4.Practical examination of 25 marks on written problems, 10 marks for problems on maxima software (5 marks for writing syntax and 5 marks to perform the same on android mobile or computer).

Semester - II

MT 121-Analytical Geometry

Unit 1: Analytical Geometry of Two Dimension (10 Lectures)

1.1. Change of axes: translation and rotation.

1.2. Conic Sections: General equation of second degree in two variables

1.3. Reductionto standard form, center of conic, nature of conic.

Unit 2: Planes (10 Lectures)

2.1. Direction cosines and direction ratios,Equation of plane, Normal form, Transform to the normal form, Plane passing through three non-collinear points, Intercept form, Angle between two planes.

2.2. Distance of a point from a plane, Distance between parallel planes, Systems of planes, two sides of planes, Bisector planes.

Unit 3: Lines in three dimension (8 lectures)

3.1. Equations of a line in Symmetric and unsymmetrical forms, Line passing through two points, Angle between a line and a plane.

3.2. Perpendicular distance of a point from a plane, Condition for two lines to be coplanar (without proof).

Unit 4: Sphere (8 Lectures)

4.1. Equation of a sphere in different forms, plane section of a sphere.

4.2. Equation of a circle, sphere through a given circle

4.3. Intersection of a sphere and a line, Equation of tangent plane to sphere.

Text Books:

1. Analytic Geometry in Two and Three Dimensions : Von Steuben

Unit1: Sec, 8.4

2. **Analytical Solid Geometry: Shantinarayan; S. Chand and Company Ltd, New Delhi, 1998.**

Unit2: Sec. 1.6,1.7, Sec. 2.1 to 2.7

Unit3: Sec. 3.1 to 3.4, 3.7

Unit4: Sec. 6.1 to 6.6.

Reference Book:

1. P.K.Jain and Khalil Ahmad,A Text Book of Analytical Geometry of Three Dimensions, Wiley Estern Ltd. 1999.

MT 122: Calculus-II

Unit 1: Differentiation (10 lectures)

1.1. The Derivatives:
Definition of the derivative of a function at a point, every differentiable function is continuous, Rules of differentiation, Caratheodary'stheorem(without proof), The chain rule, Derivative of inverse function (without proof , only examples).

1.2 The Mean Value Theorems:
Interior extremum theorem, Mean Value theorems and their Consequences, Intervals of increasing and decreasing of a function,first derivative test for extrema.

Unit 2: L' Hospital Ruleand Successive Differentiation(10 lectures)

2.1 L'Hospital Rule:
Indeterminate forms, L'Hospital Rules(without proof)

2.2 Taylor's theorem: Taylor's theorem and Maclaurin'stheorem with Lagrange's form of remainder(Without proof).

2.3 Successive Differentiation: The nth derivative and Leibnitz theorem for successive differentiation.

Unit 3: Ordinary Differential Equations (08 lectures)

3.1 Linear first order equations.

3.2 Separable equations.

3.3 Existence and Uniqueness of solutions of nonlinear equations.

Unit 4: Exact Differential Equations (08 lectures)

4.1 Transformation of nonlinear equations to separable equations.

4.2 Exact differential equations.

4.3 Integrating factors.

Textbooks:

1. **Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons, Inc., Fourth Edition.**
   Unit 1: Chapter 6: Sec. 6.1(6.1.1 to 6.1.8), Sec 6.2(6.2.1 to 6.2.8).
   Unit 2: Chapter 6: Sec 6.3(6.3.1 to 6.3.7), Sec 6.4(6.4.1 to 6.4.3).
2. **Differential Calculus by Shanti Narayan, Tenth Revised Edition.**
   Units 2: Chapter 5: Sec. 5.1 to 5.6.
3. **Elementary Differential equations, William F. Trench, E-book (Free download)**

Unit 3: Chapter 2: Sec 2.1 to 2.3.
Unit 4: Chapter 2: Sec 2.4 to 2.6.

Reference books:

1. Introduction to Real analysis, William F.Trench, Free edition, 2010.
2. Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.
3. Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.
4. Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Surgent, Addison Wesley, tenth edition.
5. Ordinary and partial Differential equations,M.D. Raisingania, S. Chand andCompany,2009.

MT 123: Mathematics Practical

(Practical based on the applications of articles in MT 121 and MT 122)

In Semester-II, we should conduct 4 written practical and 2 practical on maxima software for each paper MT-121 and MT-122.

List of Practical

Practical 1 : Problems on Unit 1 (Written) from MT-121.
Practical 2 : Problems on Unit 2 (Written) from MT-121.
Practical 3 : Problems on Unit 3(Written) from MT-121.
Practical 4 :Problems on Unit 4(Written) from MT-121.
Practical 5 : Problems on unit 1 and unit 2 from MT-121using maxima software.
Practical 6 : Problems on Unit 3 and Unit 4 from MT-121using maxima software.
Practical 7: Problems on Unit 1 (Written) from MT-122.
Practical 8 : Problems on Unit 2 (Written) from MT-122.
Practical 9 : Problems on Unit 3(Written) from MT-122.
Practical 10 :Problems on Unit 4(Written) from MT-122.
Practical 11 : Problems on unit 1 and Unit 2 from MT-122using maxima software.
Practical 12: Problems on Unit 3 and Unit 4from MT-122 using maxima software.

Note:

1 The soft copy of practical on maxima software will be prepared and provided by the Board of Studies in mathematics.
2. Practicals on maxima software can be performed on computer and android mobiles.
3. Android mobiles are allowed for practical examination on maxima software .
4.Practical examination 25 marks on written problems, 10 marks for problems on maxima software (5 marks for writing syntax and 5 marks to perform the same on android mobile or computer).

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) 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 20 marks, 10 marks on maxima software and oral examination of 05 marks.

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

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

Q1. Any 2 out of 4 each question of 5 marks on paper - I.

Q2.Any 2 out of 4 each question of 5 marks on paper - II.

Q3. (a) Any 1 out of 2 each question of 5 marks on maxima software from paper – I.

(b) Any 1 out of 2 each question of 5 marks on maxima software from paper – II.

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

7) The internal 15 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practical.

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

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

10) **Special Instruction:**

a) There should be well equipped mathematics practical laboratory of size 20 X 20 sq. fts containing at least 10 computers.

b) Examiners should set separate question papers, solutions and scheme of marking for each batch and claim the remuneration as per rule.

c) 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 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.

Savitribai Phule Pune University [SPPU]

B.Sc. (Chemistry)

(Three Years Integrated Degree Program)

Choice Based Credit System [CBCS]

From Academic Year

2019-2020

First Year (F.Y. B. Sc.)

Board of Studies (Chemistry)

Savitribai Phule Pune University [SPPU]
Pune-41107

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 : Analytical 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 Contentious assessments**
iv. **For details refer UG rules and regulations (CBCS for Science program under science & Technology) given in Appendix**

Savitribai Phule 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 : Analytical 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	

Preamble:

The syllabus of Chemistry for First year has been redesigned for Choice based Credit System (CBCS) to be implemented form 2019-2020.

In CBCS pattern semester system has been adopted for FY, SY and TY which includes Discipline Specific Core Course (DSCC) at F Y level, Ability Enhancement Compulsory Course (AECC), Discipline Specific Elective Course (DSEC) and Skill Enhancement Course (SEC). DSCC courses has been introduced at FY level and AECC courses at SY level along with DSEC. At TY level DSEC and SEC courses has been introduced.

Syllabus for Specific Core Courses of Chemistry (2 Theory and 1 Practical) subject for F. Y. B. Sc. is to be implemented from the year 2019-20. Syllabus for S. Y. and T. Y. B. Sc. will be implemented from the year 2020-21 and 2021-22 respectively as per structure approved.

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]**

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]**

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]**

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 lead 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. **[09]**

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) **[14]**

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: (Up to 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]**

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 themain 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. McMurry, 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. Samuel Glasstone, *Thermodynamics for Chemists*, Affiliated East West Private Limited.
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. Ball D. W., Physical Chemistry, Thomson Press , India (2007)
12. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
13. Atkins' Physical Chemistry –Thermodynamics and Kinetics, 11th Edition, Oxford Press
14. Thomas Engel, Philip Reid; *Physical Chemistry*, Pearson Education (2006)
15. J. N. Gurtu, A. Gurtu; *Advanced Physical Chemistry,* Pragati Edition
16. Mortimer R. G., Physical Chemistry, 3rd Edition, Elsevier, Noida (UP)
17. 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. To determine type and detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing up to 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 acids) / pigments from plant extract/ 2 organic compounds by paper chromatography
   (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Note: Combination of two compounds/plant extract 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., *Text book 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).
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 wavefunctions (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*). **[14]**

2. Periodic table and Periodicity of Elements

Periodic table: periodic table after 150 years, review on the eve of international year of periodic table[IYPT].

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

[10]

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) $XeOF_4$ **[12]**

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 $XeOF_4$.

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

1. **Introduction to Analytical Chemistry**
   What is analytical Chemistry, the analytical perspectives, Common analytical problems. **[03]**

2. **Calculations used in Analytical Chemistry**
   Some important units of measurements-SI units, distinction between mass and weight, mole, millimole and Calculations, significant figures
   Solution and their concentrations- Molar concentrations, Molar analytical Concentrations, Molar equilibrium concentration, percent Concentration, part per million, part per billion, part per thousand, Solution –dilatant volume ration, functions , density and specific gravity of solutions, problems
   Chemical Stoichiometry – Empirical and Molecular Formulas, Stoichiometric Calculations, Problems. **[10]**

3. **Qualitative Analysis of Organic Compounds**
   Types of organic compounds, characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures.
   Analysis – Detection of nitrogen, sulfur, halogen and phosphorous by Lassiagen's test.
   Purification of organic compounds- Introduction, recrystallization, distillation, sublimation **[05]**

4. **Chromatographic Techniques –Paper and Thin Layer Chromatography**
   Introduction- Introduction to chromatography, IUPAC definition of chromatography.
   History of Chromatography- paper chromatography, Thin Layer Chromatography, Ion exchange Chromatography, Gas permeation Chromatography, affinity chromatography, Gas chromatography, Supercritical fluid chromatography, High Performance Liquid Chromatography, Capillary electrophoresis, Classification of chromatographic methods – according to separation methods, according to development procedures.
   Thin Layer Chromatography: Theory and principles, outline of the method, surface adsorption and spot shape, Comparison of TLC with other forms of chromatography, adsorbents, preparation of plates, application of samples, development.
   Paper Chromatography- Origin, overview of technique, sample preparation, types of paper, solvents, equilibrium, development, sample application and detection, Identification, Quantitative methods, applications of paper chromatography **[14]**

5. pH meter

Introduction, pH meter, Glass pH electrode, combination of pH electrode-Complete Cell, Standard Buffer –reference for pH measurement, Accuracy of pH measurement, Using pH meter –How does it works? Applications of pH meter. **[04]**

Learning Outcomes

1**. Introduction to Analytical Chemistry**

i. Analytical Chemistry –branch of chemistry
ii. Perspectives of analytical Chemistry
iii. analytical problems

2. Calculations used in Analytical Chemistry

i. Calculations of mole, molar concentrations and various units of concentrations which will be helpful for preparation of solution
ii. Relation between molecular formula and empirical formula
iii. Stoichiometric calculation
iv. Define term mole, millimole, molar concentration, molar equilibrium concentration and Percent Concentration.
v. SI units, distinction between mass and weight
vi. Units such as parts per million, parts per billion, parts per thousand, solution-dilatant volume ratio, function density and specific gravity of solutions.

3 Qualitative Analysis of Organic Compounds

Basics of type determination, characteristic tests and classifications, reactions of different functional groups.

i. Separation of binary mixtures and analysis
ii. Elemental analysis -Detection of nitrogen, sulfur, halogen and phosphorous by Lassiagen's test.
iii. Purification techniques for organic compounds.

4. Chromatographic Techniques – Paper and Thin layer Chromatography

i. Basics of chromatography and types of chromatography
ii.Theoretical background for Paper and Thin Layer Chromatography

5. pH metry

i. pH meter and electrodes for pH measurement
ii. Measurement of pH
iii. Working of pH meter
iv. Applications of pH meter

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. McMurry, 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, New Delhi (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. A Braithwait and F. J. Smith, *Chromatographic method*, 5th edition, Kluwer Academic publishers
12. G D Christian -Analytical Chemistry
13. Qualitative Organic Analysis 4th Edn by A I Vogel (ELBS)
14. Vogel's Quantitative Analysis
15. Douglas A Skoog, Donald M West, F James Holler ,Stainly R Crounch , *Fundamentals of Analytical Chemistry*, 9th edition
16. David Harvey, *Modern Analytical Chemistry*, McGraw Hill Higher education
17. Gurudeep R Chatwal, Sham K Anand, *Instrumental Methods of Chemical Analysis*, Himalaya Publishing House.
18. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
19. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
20. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
21. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
22. *Atkins' Physical Chemistry,* 10th edition (2014), Oxford University Press
23. Thomas Engel, Philip Reid; *Physical Chemistry* , Pearson Education (2006)
24. J. N. Gurtu, A. Gurtu, *Advanced Physical Chemistry,* Pragati Edition
25. McQuarrie, D. A., & Simon, J. D., *Physical Chemistry: A molecular approach*. Sausalito, CA: University Science Books (1997)
26. Atkins, P., & de Paula, J., *Physical Chemistry for the Life Sciences*. New York: W. H. Freeman and Company (2006)
27. McMahon, D. (2005). *Quantum Mechanics Demystified*. NewYork: McGraw-Hill Professional
28. Ladd, M. *Introduction to Physical Chemistry* (3rd ed). Cambridge, UK: Cambridge University Press (1998)

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

Section A: Inorganic Chemistry

Wherever required standardization of volumetric reagent must be performed.

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

1) Synthesis of potash alum from aluminium metal (scrap Aluminium 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 $FeSO_4\bullet 7H_2O$

Note:

i. In synthesized compound student must confirm the particular cation and anion by performing qualitative tests.
ii. Costing of product for 100 g pack can be calculated on the basis of cost of raw materials used and percent yield of the product.
iii. Synthesized compounds should be collected from all students and stored properly. They should be used in other experiments such as Mohr's salt for determination of water of crystallization. Potash alum and $FeSO_4$ can be given in IQA experiments or for estimations at SY and TY level.

II] Volumetric Analysis (Any Two)

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Determination of basicity of boric acid or oxalic acid or citric acid hence determination of their equivalent weight.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

III] Analysis of Commercial products containing inorganic substances (any two)

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 selectively Cu(II) from brass alloy by iodometrically (Use KIO_3 as primary standard for standardization of $Na_2S_2O_3$ and **not** $K_2Cr_2O_7$).

IV] To draw polar plots of s and p orbitals.

Section B: Organic Chemistry

I] Organic Purification Techniques

1. Purification of organic compounds by i) crystallization (from water and alcohol) ii) distillation (Two Compounds), iii) Sublimation (micro technique).

II] Organic preparations: Derivatives

2. 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)
3) Semicarbazone derivatives of aldehydes and ketones
4) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone
Note: Presence of extra element in the synthesized compound must be tested (Br and N in respective compound)
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

Students 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.

CH-202: Analytical Chemistry

Students will know about basics of analytical chemistry, some techniques of analysis and able to do calculations essential for analysis.

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