University of Pune
Three Year B. Sc. Degree Course in
Botany

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Board of Studies in Botany
Univesity of Pune, Pune 411 007.

1) Title of the Course : B. Sc. Botany

F. Y. B. Sc. Botany

(To be implemented from Academic Year 2013-14)

2) Preamble:

The well organized curricula including basic as well as advanced concepts in the plant sciences from first year to the third year shall inspire the students for pursuing higher studies in Botany and for becoming an enterprenur and also enanble students to get employed in the Botany subject based indutries.

3) Introduction:

At **first year of under-graduation** the topics related to the fundamentals of Botany, including exposure to diversity in plant groups and industries related to plant sciences are covered. The practical course is aimed to equipe the students with skills required for plant identification, description, classification and also applications of these plants in various industries.

At **second year under-graduation**: The level of the theory and practical courses shall be one step ahead of the first year B.Sc. courses based on content of first year shall be introduced.

At **third year under-graduation:**Theory papers in each semester shall deal with the further detailed studies of the various plant groups and other branches of Botany such as Plant Genetics, Plant Physiology, Molecular biology etc. The students will also learn about use of Statastics in the plant sciences which will be helpful to students during research in the Botany subject.

Objectives:

- To provide thorough knowledge about various plant groups from primitive to highly evolved
- To make the students aware of applications of different plants in various industries
- To highlight the potential of these studies to become an enterpruner
- To equippe the students with skills related to laboratory as well as field based studies
- To make the students aware about conservation and sustainable use of plants
- To creat foundation for further studies in Botany
- To address the socio-economical challenges related to plant sciences

- To facilitate students for taking up and shaping a successful career in Botany

4) Eligibility:

1 **First Year B.Sc. :** A student who has passed the Higher Secondary School Certificate (10+2) Science stream with Biology or its equivalent examination as per the University of Pune eligibility norms.

2 **Second Year B.Sc. :** Keeping terms of First Year of B. Sc. with Botany as one of the subjects. Other sudents if they fulfill the conditions approved by the equivalence committee of Faculty of Science of the University of Pune are also eligible.

3 **Third Year B.Sc.:** Student shall pass all First Year B. Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Botany as one of the subjects.

Note: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune. Reservation and relaxation will be as per the Government rules.

5 A) Examination Pattern:

First Year B. Sc. Botany

Pattern of Examination: Annual

Theory courses	Botany Theory Paper I : Annual
	Botany Theory Paper II : Annual
Practical Course	Annual

Paper/ Course No.	Title	Total Number of lectures/practicals per Term	Standard of passing		
			Internal marks out of **20**	External marks out of **80**	Total marks out of **100**
Theory Paper I BO 111 (First term)	Plant Diversity	Three lectures/Week (Total 36 lectures per term)	08	32	40 *
Theory Paper I BO 111 (Second term)	Plant Morphology and Anatomy	Three lectures/Week (Total 36 lectures per term)			
Theory Paper II BO 112 (First term)	Industrial Botany I	Three lectures/Week (Total 36 lectures per term)	08	32	40 *
Theory Paper II BO 112 (Second term)	Industrial Botany II	Three lectures/Week (Total 36 lectures per term)			
Practical Paper III BO 113 (First & Second Term)	Practical	10 Practicals of 4 lectures in each term (20 practicals / year)	08	32	40 *

* Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory (100 + 100) = 200 marks
2. Total marks per year 200 (Theory) + 100 marks (practicals) = 300 marks
3. Internal marks for theory papers given on the basis of internal assessment tests

Theory examination will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	8 sub-questions, each of 2 marks; answerable in 2 -3 lines and based on entire syllabus
Question 2 and 3	4 out of 6 - short answer type questions; answerable in 8 – 10 lines
Question 4	2 out of 4 – Descriptive answer type questions, answerable in 15 – 20 lines
Question 5	1 out of 2 – Descriptive answer type questions, answerable in 35 – 40 lines

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks in each term. The written test shall comprise objective type questions – Multiple Type Questions, True / False, Definitions, Answer in one or two line questions.There shall be 20 questions.
Practical: Regular assessment of each practical for 20 marks each: Marks for journal:10, Marks for attendance: 05, Marks experimental skills: 03, Practical Work Book: 02
Practical Examination: Practical examination shall be conducted by the respective college at the end of the academic year. Practical examination will be of more than 4 hours duration. Certified journal is compulsory to appear for practical examination. There shall be two expert and two examiners per batch for the practical examination.

Second Year B. Sc. Botany

Pattern of examination: Semester
Theory courses BO 211 and BO 212: Semester

BO 221 and BO 222: Semester

Practical Course: Annual

Paper/ Course No.	Title	Total Number of lectures/practicals Per Semester	Standard of passing		
			Internal marks out of 10 (theory) Out of 20 (practicals)	External marks out of 40 (theory) Out of 80 (practicals)	Total passing marks out of 50 (theory) and out of 100 (practicals)
BO 211	Theory Paper I	Four lectures/Week (Total 48 per semester)	04	16	20 *
BO 212	Theory Paper II	Four lectures/Week (Total 48 per Semester)	04	16	20 *
BO 221	Theory Paper I	Four lectures/Week (Total 48 per Semester)	04	16	20 *
BO 222	Theory Paper II	Four lectures/Week (Total 48 per Semester)	04	16	20 *
Practical paper III (First & Second Semester)	Paper III	12 Practicals of 4 lectures in each Semester (24 practicals / year)	08	32	40**

* Subject to compulsory passing in external examination and getting minimum 20 marks out of 50

**Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory for each semester (50 + 50) = 100 marks
2. Total marks per year 200 (Theory) + 100 marks (practicals) = 300 marks
3. Internal marks for theory papers given on the basis of internal assessment tests.
4. Internal marks for Practical Course should be a regular assessment of each practical for 20 marks each: Marks for journal:10, Marks for attendance: 05, Marks experimental skills: 03, Practical Work Book: 02

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying equal marks as follows: The pattern of question papers shall be:

Question 1	10 sub-questions, each of 1 marks based on entire syllabus	10 marks
Question 2 and 3	2 out of 3 sub-questions, each of 5 marks; short answer type questions; answerable in 10-15 lines	5 marks each
Question 4	1 out of 2 sub-questions, each of 10 marks; long answer type questions (20-25lines)	10 marks

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each Semester. The written test shall comprise of objective type questions – Multiple Type Questions, True / False, Definitions, Answer in Two or three line question. There shall be 20 questions.
Practicals: Regular assessment as described earlier (regular assessment of each practical for 20 marks each: Marks for journal:10, Marks for attendance: 05, Marks experimental skills: 03, Practical Work Book: 02)
Practical Examination: Practical examination shall be conducted at the respective college at the end of the academic year. Practical examination will be of more than 4 hours duration. Certified journal is compulsory to appear for practical examination. There shall be two expert and two examiners per batch for the practical examination. One of the examiners will be external.

Third Year B. Sc. Botany

Pattern of examination: Semester

Theory courses:

(Sem III: BO 331 – BO 336) : Semester

(Sem IV: BO 341 – BO 346) : Semester

Practical Course:

(BO 347 – BO 349) : Annual

Theory Papers					
Paper/Course No.	Title	Total Number of lectures Per Semester	Standard of passing		
			Internal marks out of 10 (theory) Out of 20 (practicals)	External marks out of 40 (theory) Out of 80 (practicals)	Total passing marks out of 50 (theory) and out of 100 (practicals)
SEM III					
BO 331	Paper I	48	4	16	20*
BO 332	Paper II	48	4	16	20*
BO 333	Paper III	48	4	16	20*
BO 334	Paper IV	48	4	16	20*
BO 335	Paper V	48	4	16	20*
BO 336	Paper VI	48	4	16	20*
SEM IV					
BO 341	Paper I	48	4	16	20*
BO 342	Paper II	48	4	16	20*
BO 343	Paper III	48	4	16	20*
BO 344	Paper IV	48	4	16	20*
BO 345	Paper V	48	4	16	20*
BO 346	Paper VI	48	4	16	20*
Practical Papers					
BO 347 (Semester III & IV)	Practical Paper I	12 Practicals of 4 lectures in each Semester (24 / year)	08	32	40 **
BO 348 (Semester III & IV)	Practical Paper II	12 Practicals of 4 lectures in each Semester (24 / year)	08	32	40 **
BO 349 (Semester III & IV)	Project Practical Paper III	12 Practicals of 4 lectures in each Semester (24 / year)	08	32	40 **

* Subject to compulsory passing in external examination and getting minimum 20 marks out of 50
**Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory for each semester (50 × 6) = 300 marks
2. Total marks per year 600 (Theory) + 300 marks (practicals) = 900 marks
3. Internal marks for theory papers be given on the basis of internal assessment tests.
4. Practicals: Regular assessment as described earlier (regular assessment of each practical for 20 marks each: Marks for journal:10, Marks for attendance: 05, Marks experimental skills: 03, Practical Work Book: 02)

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying marks as per the table. The pattern of question papers shall be:

Question 1	10 sub-questions, each of 1 marks based on entire syllabus	10 marks
Question 2 and 3	2 out of 3 sub-questions, each of 5 marks; short answer type questions; answerable in 10 – 15 lines	5 marks each
Question 4	2 out of 3 sub-questions, each of 10 marks; long answer type questions (20 – 25 lines)	10 marks

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each Semester. The written test shall comprise of objective type questions – Multiple Type Questions, True / False, Definitions, Answer in Two or three line question. There shall be 20 questions.
Practicals: Regular assessment as described earlier (regular assessment of each practical for 20 marks each: Marks for journal:10, Marks for attendance: 05, Marks experimental skills: 03, Practical Work Book: 02)

Practical Examination: Practical examination shall be conducted at the respective college at the end of the academic year. Practical examination will be of more than 4 hours duration. Certified journal is compulsory to appear for practical examination. There shall be two expert and two examiners per batch for the practical examination. One of the examiners will be external.

5 B) Standard of Passing:

i. In order to pass in the first year theory examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks out of 80 must be obtained in the University Theory Examination.)
ii. In order to pass in the Second Year and Third Year theory examination, the candidate has to obtain 20 marks out of 50 in each course of each semester. (Minimum 16 marks out of 40 must be obtained in the University Theory Examination.)
iii. In order to pass in practical examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks out of 80 must be obtained in the University Examination.)

5 C) ATKT Rules:

While going from F.Y.B.Sc. toS.Y.B.Sc. at least 8 courses (out of total 12) should be passed; however all F.Y.B.Sc. courses should be passed while going to T.Y.B.Sc.
While going from S.Y.B.Sc. toT.Y.B.Sc., at least 12 courses (out of 20) should be passed (Practical Course at S.Y.B.Sc. will be equivalent to 2 courses).

5 D)Award of Class:

The class will be awarded to the student on the aggregate marks obtained during the second and third year in the principal subject only. The award of the class shall be as follows:

1	Aggregate 70% and above	First Class with Distinction
2	Aggregate 60% and more but less than 70%	First Class
3	Aggregate 55% and more but less than 60%	Higher Second Class
4	Aggregate 50% and more but less than 55%	Second Class
5	Aggregate 40% and more but less than 50%	Pass Class
6	Below 40%	Fail

5 E) External Students: There shall be no external students.

5 F) Setting question papers:

F. Y. B. Sc.: For theory papers I and II annual question papers shall be set by the University of Pune and assessment done at the respective colleges. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject. For Practical Paper III,

papers shall be set by the University of Pune and assessment done at the respective colleges.

S. Y. B. Sc. and T. Y. B. Sc.: For theory papers for each semester and also for the annual practical examination, question papers shall be set by the University of Pune. Centralized assessment for theory papers done as per the University instructions. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject. For Practical Papers,papers shall be set by the University of Pune and assessment done by the internal examiner and external examiner appointed by University of Pune.

5 G)Verification and Revaluation Rules:
As per university Statues and Rules for verification and revaluation of marks in stipulated time after declaration of the semester examination result.

6) Course Structure:

Duration: The duration of B.Sc. Botany Degree Program shall be three years.

a) Compulsory Papers:
F. Y. B. Sc.: 2 Theory + 1 Practical (Annual)
S. Y. B. Sc.: 2 Theory per semester + 1 Practical (Annual)
T. Y. B. Sc.: 6 Theory per semester + 3 Practical (Annual)

b) Question Papers :

F. Y. B. Sc. Theory paper:
University Examination – 80 marks (at the end of 2nd term)
Internal Examination – 20 marks
S. Y. / T. Y. - B. Sc. Theory paper:
University Examination – 40 marks (at the end of each term)
Internal Examination – 10 marks
F. Y. / S. Y. / T. Y. - B. Sc. Practical Paper:
University Examination – 80 marks (at the end of 2nd term)
Internal Examination – 20 marks

c) Medium of Instruction: The medium of instruction for the course shall be **English.**

7) Equivalence of Previous Syllabus:

Old Course (2008 Pattern)	**New Course (2013 Pattern)**
Paper I: Plant Diversity	BO 111: Plant Diversity, Plant Morphology and Anatomy
Paper II: Plant Resources -Utiliation and Management	BO 112: Industrial Botany
Paper III: Practical	BO 113: Practical

8) 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 75 percent attendance at theory and practical course and satisfactory performance during the term.

9) Qualification of Teachers: M.Sc. Botany or equivalent master degree in science with class/grades and NET/SET/Ph.D. as per prevailing University/Government /UGC rules.

UNIVERSITY OF PUNE
BOARD OF STUDIES IN BOTANY
Proposed Revised Syllabus for F. Y. B. Sc. (Botany)
To be implemented from June, 2013
F. Y. B. Sc. (Botany) New Syllabus

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1. **Fundamentals of Botany: PAPER – I**

   Term- I: Plant Diversity

2. **Botany Theory Paper II**

   Term I – Industrial Botany

3. **Fundamentals of Botany: PAPER - I**

   Term- II: Morphology and Anatomy

4. **Botany Theory Paper II**

   Term- II – Industrial Botany

5. **F. Y. B. Sc. Botany Practical Paper - III based on Theory Paper I and Paper II**

UNIVERSITY OF PUNE
BOARD OF STUDIES IN BOTANY
Proposed Revised Syllabus for F. Y. B.Sc. (Botany)
To be implemented from June, 2013
PAPER – I
FUNDAMENTALS OF BOTANY
Term – I: Plant Diversity (36 Lectures)

1. **Introduction**: General outline of plant kingdom, Introduction to plant diversity with reference to following groups:-

   Cryptogams: Thallophyta (Algae, Fungi, Lichens, And Bacteria), Bryophyta and Pteridophyta, Phanerogams: Gymnosperms and Angiosperms. **3L**
2. **Algae**: General characters, Outline classification according to G.M. Smith (1955) up to classes with reasons. Life cycle of *Spirogyra*. **6L**
3. **Fungi**: General characters, Outline classification according to G.M. Smith (1955) up to classes with reasons. Life cycle of *Cystopus (Albugo).* **5L**
4. **Lichens**: General characters, Nature of Association, Types of Lichens on the basis of thallus morphology, Economic importance of lichens. **3L**
5. **Bryophytes**: General characters, Outline classification according to G.M. Smith (1955) up to classes with reasons. Life cycle of *Riccia.* **5L**
6. **Pteridophytes**: General characters, Outline classification according to G.M. Smith (1955) up to classes with reasons. Life cycle of *Nephrolepis*. **6L**
7. **Gymnosperms**: General characters, Outline classification according to Chamberlain (1934) up to classes with reasons. Life cycle of *Cycas*. **5L**
8. **Angiosperms**: General characters, Causes of evolutionary success of Angiosperms, comparative account of monocotyledons and dicotyledons. **3L**

   (Note: Development of sex organs not expected, for all the above mentioned life cycles)

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PAPER – I

FUNDAMENTALS OF BOTANY

Term – II: Morphology and Anatomy (36 Lectures)

1. **Morphology**: **4L**

1.1: Introduction, Definition and Scope.

1.2: Descriptive and Interpretative.

1.3: Importance in identification, nomenclature, classification, phylogeny and Plant breeding.

2**. Morphology of Vegetative Parts: 8L**

2.1: **Root**: Types of roots, Modifications of roots: Epiphytic, Respiratory (Pneumatophores), Parasitic and Storage roots (conical, fusiform and napiform) with examples; functions of root.

2.2: **Stem**: Modifications of Stem: Phylloclade, Runner, Stolon, Suckers, Offsets, Rhizome, Corm, Tuber and Bulb with examples. Functions of stem.

2.3: **Leaf**: Parts of typical leaf: petiole, lamina; leaf margins and apices. Types of leaves: simple, compound, venation, phyllotaxy. Modifications: tendrils, spines, scale leaves, phyllode, reproductive and trap leaves (mechanism of trapping in *Nepenthes* only) with examples. Functions of leaf.

3. Morphology of Reproductive Parts: 10L

3.1: **Inflorescence**: Types of inflorescence: Racemose (raceme, spike, corymb, umbel, catkin, spadix and capitulum), Cymose (solitary, monochasial, dichasial, polychasial), Special types (Verticillaster, Cyathium, and Hypanthodium) Significance.

3.2: **Flower**: Parts of typical flower, Types of flower (complete, incomplete), symmetry of flower and insertion of floral whorls. Floral whorls: Calyx, corolla, perianth, aestivation, modifications of calyx (pappus, petalloid, spurred), forms of corolla: polypetalous (cruciform and papilionaceous) gamopetalous (infundibuliform, bilabiate), Androecium: structure of stamen, fixation of anthers, cohesion and adhesion; Gynoecium: structure of carpel. Types of placentations.

3.3: **Fruit**: Types of fruits: Simple and dry: Achene, Cypsela, Legume, Follicle and Capsule, Fleshy: Drupe, berry, Hespiridium and pepo. Aggregate: Etaerio of berries and Etaerio of follicles. Multiple fruits: Syconus and Sorosis.

3.4: **Seed**: Parts, types, structural modifications for seed dispersal.

4. **Anatomy**: **2L**

Introduction, Definition, Importance in taxonomy, physiology, ecological interpretations, pharmacognosy and wood identification.

5. **Types of tissues:** Outline with brief description. **6L**

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

5.2: **Vascular tissues:-** Components of xylem and phloem, types of vascular bundles, functions.

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

5.4: **Mechanical tissues**:- Collenchyma, sclerenchyma and xylem with functions.

6. Internal Organization of Primary Plant Body: 6L

6.1: Internal structure of dicotyledon and monocotyledon root.

6.2: Internal structure of dicotyledon and monocotyledon stem.

6.3: Internal structure of dicotyledon and monocotyledon leaf.

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PAPER- II

Term I – INDUSTRIAL BOTANY (36 Lectures)

1. **Introduction to Industrial Botany** **2L**

1.1 Concept of Industrial Botany.

1.2 Plant resources and industries: Food, fodder, fibers, medicines, timber, dyes, gum, tannins. (Two examples of each resource and the relevant industries with which they are associated).

2. **Floriculture Industry** **8L**

2.1 Introduction to floriculture.

2.2 Important floricultural crops, open cultivation practices, harvesting and marketing of Tuberose.

2.3 Greenhouse technology: Concept, advantages and limitations.

2.4 Cultivation practices (greenhouse technology), harvesting and marketing of Rose and *Gerbera.*

3. **Plant Nursery Industry** **8L**

3.1 Concept and types of nurseries: ornamental plant nursery, fruit plant nursery, medicinal plant nursery, vegetable plant nursery, orchid nursery, forest nursery (with reference to infrastructure required, outputs, commercial applications and profitability).

3.2 Propagation methods: Seed propagation, natural vegetative propagation and artificial vegetative propagation (Cutting: Stem, Layering: Air layering, Grafting: Stone grafting and Approach grafting, Budding : T-budding).

4 **Plant Tissue Culture Industry** **6L**

4.1 Concept of tissue culture.

4.2 Culture techniques: Types of explants, preparation of media, methods of sterilization, inoculation techniques, incubation and hardening.

4.3 Commercial significance

5. Agri industries: **8L**

5.1 Organic Farming: Concept, need of organic farming, types of organic fertilizers, advantages and limitations.

5.2 Seed industries: Importance of seed industries, seed production, seed processing and seed marketing with reference to cotton. Major seed industries and corporations of India.

6. Mushroom Industries: 4L

Mushroom cultivation: Plant resources, cultivation practices of Oyster mushroom, uses of mushrooms, value added products, commercial significance.

References:

1. Textbook of Economic Botany, Verma V., Ane Books Pvt. Ltd.
2. Economic Botany in the Tropics, Kochhar, Macmillan Publisher.
3. Economic Botany: Principles and Practices, Gerald E. Wickens, Springer Publication.
4. Floriculture in India, Gurcharan Singh Randhawa and Amitabha Mukhopadhyay, Allied Publishers.
5. Floriculture Marketing in India, Debashish Sengupta and Raj Kamal, Excel Books.
6. Floriculture Hand Book, Eiri, Engineers India Research in Publication.
7. Nursery Management, John Mason, Landlinks Press Publisher.
8. Plant Nursery Management: How to Start and Operate a Plant Nursery, Ray, P.K., Scientific Publishers.
9. Introduction to Plant Tissue Culture (2/e), M. K. Razdan, Science Publishers.
10. Plant Cell and Tissue Culture, Indra K. Vasil, (Eds. - Indra K. Vasil, Trevor A. Thorpe), Springer Publication.
11. The Complete Book on Organic Farming and Production of Organic Compost, NPCS Board of Consultants & Engineers, Asia Pacific Business Press Inc.
12. The Organic Farming Manual: A Comprehensive Guide to Starting and Running a Certified Organic Farm, Ann Larkin Hansen, Storey Publications.
13. Hand Book of Mushroom Cultivation, Processing and Packaging, Engineers India Research In Publishers
14. Growing Gourmet and Medicinal Mushrooms, Paul Stamets, Ten Speed Press Publishers
15. Handbook of Seed Science And Technology: Seed biology, Production, and Technology, Amarjit S. Basra, Food Products Press publishers.

PAPER- II

Term- II: INDUSTRIAL BOTANY (36 Lectures)

1. Bio-fuel Industry **6L**

1.1 Introduction and advantages.

1.2 Concept of biofuel and its need.

1.3 Plants used for biofuel production.

1.4 Biodiesel production from Caster.

1.5 Commercial significance.

2 Bio-pesticide Industry **6L**

2.1 Concept of bio-control; Integrated Pest Management (IPM).

2.2 Importance of bio pesticides.

2.3 Types of bio pesticides: Indiara, Azadiractin.

2.4 Commercial significance.

3. Industrial Mycology **6L**

3.1 Introduction

3.2 Important genera of fungi used in various industries and their products.

3.3 Products and applications of *Trichoderma*, *Penicillium*, *Aspergillus* and yeast.

3.4 Commercial significance.

4. Bio-Fertilizer Industry **6L**

4.1 Bio fertilizers : concept and need

4.2 Types of bio-fertilizers: Nitrogen fixing bio fertilizer: *Rhizobium*, Blue green algae. *Anabaena* associated with *Azolla*. Phosphate solubilizing bio-fertilizer: Bacteria and Fungi.

4.3 Commercial significance.

5 Fruit Processing Industry **6L**

5.1 Fruit processing: concept and need

5.2 Cold storage.

5.3 Types of fruit processing (canned fruits, dried fruit chips, fruit pulp, squash, jam, jelly, pickle and ketchups).

5.4 Commercial significance.

6 Plant Pharmaceutical Industry **6L**

6.1 Concept and advantages.

6.2 Types of pharmaceutical products: Churna, Asava and Arishta.

6.3 Drug plants with reference to botanical source, active principles and medicinal uses of *Adathoda zeylanica*, *Tinospora cordifolia* and *Asperagus racemosus*.

6.4 Manufacture of *Churna (Triphala churna)*, *Arishta* (*Ashokarishta*) and *Asava* (*Kumariasava*).

6.5 Concept of nutraceuticals and cosmeceuticals.

6.6 Commercial significance of Amla and Aloe.

References:

1. The Complete Book on Organic Farming and Production of Organic Compost, NPCS Board of Consultants & Engineers, Asia Pacific Business Press Inc.
2. The Organic Farming Manual: A Comprehensive Guide to Starting and Running a Certified Organic Farm, Ann Larkin Hansen, Storey Publications.
3. Deore and Laware (2011).Liquid Organic Fertilizer: An Approach towards Organic Vegetable Production. LAP LAMBERT Academic Publishing (2011)
4. A Pharmacognosy and Pharmacobiotechnology. New Age international (P) Limited, Publishers (formerly Wiley Eastern Limited)
5. Kokate C.K. Practical Pharmacognosy, Vallabh Prakashan, New Delhi,
6. Kokate C.K. Purohit A.P. and Gokhale S.B. Pharmacognosy, Nirali Prakashan Pune
7. Trease G.E. and Evans. W.C. Pharmacognosy ELBS Twelfth Edition
8. Tyler V.E. Brady L.R. and Robbers J.E. Pharmacognosy Lea and Febiger. Philadelphia.8th edition KM Varghese and Co. Mumbai,
9. Vaidya S.S. and Dole V.A. Bhaishyajakalpana, Anmol Prakashan, pune
10. Wallis T.E. Text books of pharmacognosy CBS publishers and distributors New Delhi (Latest Edition)
11. Pathak, Khatri, Pathak, 2003, Fundamentals of plant pathology, Agrbios
12. Mehrotra, R.S. 1991, Plant Pathology, Tata Mc-Graw Hill Co. Delhi
13. Chattergee, P.B., 1997,Plant Protection Techniques, Bharati Bhawan, Publ. Patana
14. Agrios, G.N. 2006 Plant Pathology, Elsevier Academic Press.
15. Pandey, B.P. 2009, Plant Pathology, S. Chand Co.

16. Gupta, G.P., 2004, Text book of plant diseases, Discovery Publ. House, New, Delhi
17. Singh, R.S. 2004, Plant Diseases, Oxford & IBH Publishing Co. Pvt. Ltd., Delhi.
18. Zhiqiang A.N. (2004) Handbook of Industrial Mycology. CRC Press
19. Gary Leatham (1993) Frontiers in Industrial Mycology. Springer
20. Sueli Rodrigues; Fabiano Andre Narciso Fernandes (2012). Advances in Fruit Processing Technologies. CRC Press
21. Hui. Y. H. (3008) Handbook of Fruits and Fruit Processing John Wiley & Sons, 04-Aug-2008.
22. A.C. Gaur (Biofertilizers in Sustainable Agriculture. IARI, New Delhi
23. The Complete Technology Book on Biofertilizer and Organic Farming. NIIR PROJECT CONSULTANCY SERVICES.

F. Y. B.Sc. BOTANY PRACTICAL PAPER – III

Based on Theory Paper I and Paper II

1. Modifications of root and stem. 1P
2. Study of leaf (parts of leaf, types: simple and compound; sessile and petiolate; venation: parallel and reticulate) (Glossary of terminologies be given with the protocol). 1P
3. Study of Inflorescence. 1P
   a) Racemose: Raceme, Spike, Spadix, Catkin, Umbel and Capitulum.
   b) Cymose: Solitary cyme, Uniparous cyme: helicoid and scorpiod, Biparous cyme and Multiparous cyme.
   c) Special type: Verticillaster, Hypanthodium and Cyathium.
4. Study of flower with respect to Calyx, Corolla and Perianth: (Glossary of terminologies is given with the protocol). 1P
5. Study of flower with respect to Androecium and Gynoecium. 1P
6. Study of fruits and seed with suitable examples. 1P

   Simple fruit: fleshy – Berry and Drupe; Dry: Achene, Cypsella and Legume

   Agrregate fruit: Etaerio of follicles and Etaerio of Berries.

   Multiple fruit: Syconus and Sorosis.

   Seed: parts of seed and types of seed (monocotyledonous dicotyledonous, albuminous, exalbuminous)
7. Study of internal primary structure of dicotyledonous root, stem and leaf. e.g. Sunflower. 1P
8. Study of internal primary structure of monocotyledonous root, stem and leaf. e.g. Maize. 1P
9. Study of *Spirogyra.* 1P
10. Study of *Cystopus (Albugo)* 1P
11. Study of *Riccia*. 1P
12. Study of *Nephorlepis.* 1P
13. Study of *Cycas.* 1P
14. Study of plant resources in industries: food, fodder, fiber, medicine, timber and gum (one example of each) 1P

15. Study of artificial plant propagation: 1P

    Stem cutting (demonstration of three subtypes)

    Air Layering, Approach grafting, and T- budding

16. Study of plant tissue culture techniques: Demonstration of various stages. 1P

17. Cultivation of Oyster mushroom and demonstration of value added mushroom products. 1P

18. Study of plant resources used in biopesticides. 1P

    (Indiara, Azadiractin)

19. Study of industrially important fungi and their products. 1P

    Ganoderma: *Ganoderma* tablets, *Aspergillus*: citric acid; *Yeast*: Bakery products; *Penicillium*: Penicillin and *Trichoderma*.

20. Study of types of Biofertilizers: *Rhizobium*, *Azatobacter*, BGA, *Azolla*.

    Phosphate Solubilizing Bacteria. Green manure (preferably Crotolaria/ Gliricidia/locally available material). 1P

21. Preparation of Jam and Squash. 1P

22. A) One botanical excursion to study plant diversity.

B) Visit to one of the following industries. (Study/project report is compulsory).
1) Floriculture unit 2) Greenhouse 3) Pharmaceutical industry 4) Nursery and 5) Mushroom cultivation unit.

(Note: Visits mentioned in the practical No. 22 (A & B) are compulsory. It carries 10 marks at the time of annual practical examination.)

University of Pune

Three Year B. Sc. Degree Course in

Chemistry

Title of the Course : B. Sc. Chemistry

F.Y.B.Sc. Chemistry

(To be implemented from Academic Year 2013-14)

AIMS AND OBJECTIVES

- F.Y. B. Sc. Chemistry syllabus has been revised as per BCUD directives.
- The content of the syllabus have been framed as per UGC norms.
- The students are expected to understand the fundamentals, principles, mathematical concepts and recent developments in the subject area.
- The practical course is in relevance to the theory courses to improve the understanding of the concepts.
- It would help in development of practical skills of the students.
- It is expected to inspire and boost interest of the students towards chemistry as the main subject.
- It would enable to develop interdisciplinary approach of the subjects for students opting for specialization in other subjects at latter stages of graduation.

2) Preamble:

The systematic and planned curricula from first year to the third year shall motivate and encourage the students for pursuing higher studies in various disciplines of Chemistry such as Physical, Inorganic, Organic, Analytical, Drug and Biochemistry. This curriculum also enable student to shoulder the responsibility as Chemist in chemical industry.

3) Introduction:

At **first year of under-graduation**The basic topics related to the fundamentals of chemistry covered. Since chemistry is an experimental subject, practical courses is intended to achieve the basic skills required for understanding the concepts and authenticating the basic laws and principles of Chemistry.

At **second year under-graduation**: The level of the theory and practical courses shall be one step ahead of the first year B.Sc. Courses based on content of first yearshall be introduced. For the development of vertical growth in the subject, advanced level topics are introduced so as to make the sudent mature enough to pursue the carrer in Chemistry.

At **third year under-graduation:**Theory papers in each semester deal with the further detailed studies of the various branches of Chemistry as well as some specialized topics like Industrial and Environmental Chemistry. Such a designing of course structure enables the student to understand fundamental as well as applied components that are pertinent to Chemistry. Also, practical courses are framed towards development of synthetic as well as analytical skills that are essential for academic and professional life.

Objectives:

- To provide indepth knowledge of scientific and technological aspects of Chemistry
- To familiarize with current and recent developments in Chemistry
- To enrich knowledge through programmes such as industrial visits, projects etc.
- To train students in skills related to Chemistry for academic and industrial requirement.
- To creat foundation for research and development in Chemistry
- To develop analytical abilities for independent thinking
- To help students build-up a progressive and successful career in Chemistry

4) Eligibility:

1 **First Year B.Sc.:**Higher Secondary School Certificate (10+2) Science stream or its equivalent Examinationas per the University of Pune eligibility norms.

2 **Second Year B.Sc.:** Keeping terms of First Year of B. Sc. with Chemistry as one of the subjects. Other sudents if they fulfill the conditions approved by the equivalence committee of Faculty of Science of the University of Pune are also eligible.

3 **Third Year B. Sc.:** Student shall pass all First Year B. Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Chemistry as one of the subjects.

Note: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune.Reservation and relaxation will be as per the Government rules.

5 A) Examination Pattern:

First Year B. Sc. Chemistry

Pattern of Examination: Annual

Theory courses C-1: Chemistry Paper I: Annual
C-2: Chemistry Paper II: Annual

Practical Course C-3: Chemistry Paper III: Annual

Paper/ Course No.	Title	Total Number of lectures/practicals per Term	Standard of passing		
			Internal marks out of **20**	External marks out of **80**	Total marks out of **100**
Paper-I (First term)	Physical and Inorganic Chemistry	Three lectures/Week (Total 36 lectures per term)	08	32	40 *
Paper -I (Second term)	Physical and Inorganic Chemistry	Three lectures/Week (Total 36 lectures per term)			

Paper - II (First term)	Organic and Inorganic Chemistry	Three lectures/Week (Total 36 lectures per term)	08	32	40 *
Paper -II (Second term)	Organic and Inorganic Chemistry	Three lectures/Week (Total 36 lectures per term)			
Paper -III (First & Second Term)	Practical	10 Practicals of 4 lectures in each term (20 practicals / year)	08	32	40 *

* Subject to compulsory passing in external examination and getting minimum 40 marks out of 100

Notes:

1. Total marks: Theory (100 + 100) = 200 marks
2. Total marks per year 200 (Theory) + 100 marks (practicals) = 300 marks
3. Internal marks for theory papers given on the basis of internal assessment tests and for practicals on internal assessment tests + journals + attendance + study visit reports/ market survey/hobby projects etc.

Theory examination will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	8 sub-questions, each of 2 marks; answerable in 2 -3 lines and based on entire syllabus
Question 2, 3 and 4	4 out of 6– short answer type questions; answerable in 8 – 10 lines
Question 5	4 out of 6 – problem type question; answerable in numerical or analytical fashion

Internal examination: Internal assessment of the student by respective teacher will be based on written test, 10 marks each term. The written test shall comprise of objective type questions – Multiple Type Questions, True / False, Definitions, Answer in Two or three line question (Describe/Explain).There shall be 20 questions.
Practical: one internal assessment test + marks for journals + attendance + activity.

Practical Examination: Practical examination shall be conducted by the respective college at the end of the academic year. Practical examination will be of 6 hours duration (2-Sessions). Certified journal is compulsory to appear for practical examination. There shall be two expert and two examiners per batch for the practical examination.

5 B) Standard of Passing:

i. In order to pass in the first year theory examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks out of 80 must be obtained in the University Theory Examination.)

ii. In order to pass in the Second Year and Third Year theory examination, the candidate has to obtain 20 marks out of 50 in each course of each semester. (Minimum 16 marks out of 40 must be obtained in the University Theory Examination.)
iii. In order to pass in practical examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks out of 80 must be obtained in the University Examination.)

5 C) ATKT Rules:

While going from F.Y.B.Sc. to S.Y.B.Sc. at least 8 courses (out of total 12) should be passed.

5 D)Award of Class:

The class will be awarded to the student on the aggregate marks obtained during the second and third year in the principal subject only. The award of the class shall be as follows:

1	Aggregate 70% and above	First Class with Distinction
2	Aggregate 60% and more but less than 70%	First Class
3	Aggregate 55% and more but less than 60%	Higher Second Class
4	Aggregate 50% and more but less than 55%	Second Class
5	Aggregate 40% and more but less than 50%	Pass Class
6	Below 40%	Fail

5 E) External Students: There shall be no external students.

5 F) Setting question papers:

F.Y.B.Sc.: For theory papers I and II annual question papers shall be set by the University of Pune and assessment done at the respective colleges. Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject. For Practical Paper III,papers shall be set by the University of Pune and assessment done at the respective colleges.

5G)Verification and Revaluation Rules:
As per university Statues and rules for verification and revaluation of marks in stipulated time after declaration of the semester examination result.

6) Course Structure:

Duration: The duration of B.Sc. Chemistry Degree Program shall be three years.

a) Compulsory Papers:
F.Y.B.Sc. : 2 Theory + 1 Practical (Annual)

b) Question Papers :

F.Y.B.Sc.Theory paper:
University Examination – 80 marks (at the end of 2nd term)
Internal Examination – 20 marks
F.Y. B.Sc.Practical Paper:

University Examination – 80 marks (at the end of 2nd term)
Internal Examination – 20 marks

c) Medium of Instruction: The medium of instruction for the course shall be **English.**

7) Equivalence of Previous Syllabus:

Old Course (2008 Pattern)	**New Course (2013 Pattern)**
Paper I: Physical and Inorganic Chemistry	Paper I: Physical and Inorganic Chemistry
Paper II: Organic and Inorganic Chemistry	Paper II: Organic and Inorganic Chemistry
PaperIII: Practical	PaperIII: Practical

8) 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 75 percent attendance at theory and practical course and satisfactory performance during the term.

9) Qualification of Teachers:M.Sc. Chemistry or equivalent master degree in science with class/grades and NET/SET as per prevailing University/Government /UGC rules.

Chemistry Paper - I

Physical and Inorganic Chemistry

Term - I

Chapter 1	States of Matter	08
Chapter 2	Surface Chemistry	08
Chapter 3	Chemical Mathematics	08
Chapter4	Mole Concept, Stoichiometric and Numerical, Oxidation- reduction	12

Term - II

Chapter 4	Atomic Structure	12
Chapter 5	Chemical Thermodynamics	12
Chapter 6	Chemical Bonding	12

Chemistry Paper - II

Organic and Inorganic Chemistry

Term - I

Chapter1	Chemical Bonding in Organic Molecules	12
Chapter 2	Chemistry of Hydrocarbons	12
Chapter 3	Chemistry of s-block elements	12

Term - II

Chapter 4	Chemistry of Functional Groups	12
Chapter 5	Stereochemistry	12
Chapter 6	Chemistry of p-block elements	12

Chemistry Paper - III

Practical Course

1. Physical Chemistry : 7 experiments
2. Inorganic Chemistry: 7 experiments
3. Organic Chemistry : 7 experiments

PAPER - I: PHYSICAL & INORGANIC CHEMISTRY

TERM - I

Chapter 1: States of Matter
(08)

Introduction: States of matter and their properties.
Gaseous states: Significance of ideal and kinetic gas equation (no derivation), Real gases-Compressibility factor, van der Waal's equation of state, Isotherms of CO_2, critical constants, correlation between critical constants and van der Waal's constants.
Liquid state – Properties of liquids , Comparison between gaseous and solid state – Experimental determination of vapor pressure by isoteniscopic method and viscosity by Ostwald method, liquid crystals and their applications.

Aims & Objectives:

I) This topic makes understanding of behavior of gases, ideal gas as a model system and its extension to real gases. The dependence of physical state on pressure, volume and temperature is being realized.

II) The existence of liquid state, comparison of its properties with other states is to be perceived. Liquid crystal are essentials in all common and research devices and instruments hence they are introduced briefly.

III) Student should be able to solve problems regarding van der Waal's and Critical constant and regarding P-V-T relations.

IV)

Chapter 2: Surface Chemistry (08)

Adsorption: Types of adsorption, adsorption isotherms, Freundluich isotherm, Langmuir isotherm, adsorption of gases on solids, adsorption of solutes on solids, applications of adsorption,
Catalysis : Phenomena of catalysis, types of catalysis-homogeneous and heterogeneous catalysis, gaseous reactions on solid surfaces.
Colloids: Definition and classification, preparation of emulsions, gels and sols, properties of suspensoids.

Aims & Objectives:

Theoretical basis of adsorption phenomena is integrated. Understanding dynamic nature of surface and its applications in catalysis and in dispersed phases will lead to new area of nanoscience.

Chapter 3: Chemical Mathematics (08)

Functions and variables: Variables as function , variables used in chemistry
Derivative: Rules of differentiation, examples on derivatives of algebraic, logarithmic and exponential functions, partial differentiation, conditions for maxima and minima, problems related to chemistry,

Integration: Rules of integration (algebraic, exponential and logarithmic functions), Integration –definite and indefinite, problems related to chemistry.
Graph: Plotting graphs of linear, exponential and logarithmic functions and their characteristics, sketching of s and p orbitals.

Aims & Objectives:

Mathematical background required for derivations, depictions and problem solving. This chapter strengthens these aspects.

Chapter 4: Mole Concept and Oxidation-reduction (12)

Mole concept-Determination of mol. Weight by gram molecular volume relationship, problems based on mole concept. Methods of expressing concentrations, strength, normality, molarity, molality, %w/v, %v/v, ppm, standardization of solutions, primary & secondary standard substances, Preparation of standard solution of acids & bases, problems related to acid base titrations only.

Oxidation & reduction-Definitions to related terms like oxidation, reduction, oxidizing agent, reducing agent, oxidation number, Balancing of redox reactions using oxidation number method & ion electron method, problems based one equivalent weight of oxidant & reductants.

Ref: 8, 9, 10 & 11

Aims and objectives-

Students should know

1) Mole concept

2) GMV relationship

3) Student should be able to solve problems based on GMV relationship.

4) Normality, Molarity, Normal solution, Molar solution, equivalent weight, ppm, %w/v, %v/v & related problems.

5) Standard solution, primary & secondary standard substances, standerdisation of solution & related problems.

6) Understand the concept of oxidation & reduction, oxidizing agent, reducing agent, redox reaction, oxidation number, Balance the equation by ion electron method & oxidation number method.

8) Calculation of Equivalent weight of oxidant & reductant.

Term - II

Chapter 4: Atomic Structure (12)

Introduction, atomic spectrum of hydrogen, Bohr model of hydrogen atom-derivation of atomic radius and energy, energy level diagram of hydrogen atom , Failure of Classical mechanics- black body radiation, photoelectric effect, electron diffraction, atomic spectra, quantization of energy, de Broglie's hypothesis, Heisenberg's uncertainty principle (without proof), wave equation, time independent Schrödinger equation, hydrogen atom (expressions only)., wave functions for s and p atomic orbitals,

Aims & Objective

Atom being most important micro particle in construction of matter, modern developments of its structure is presented. The quantization of energy and duality of matter in this context is elaborated . Schrodinger equation is the basis of quantum chemistry that has been introduced for simplest system hydrogen atom.

Chapter 5: Chemical Thermodynamics (12)

Introduction, first law of thermodynamics and its limitations, Carnot cycle and efficiency, Entropy and second law of thermodynamics, entropy as a state function, Entropy change in isolated system, reversible and irreversible process, entropy change in ideal gases – isothermal , isobaric , isochoric processes , entropy change in physical transitions , entropy change in chemical reactions, statistical definition of entropy, absolute entropy, third law of thermodynamics

Aims & Objectives:

Natural changes are understood with the help of second and third laws of thermodynamics . These laws are presented with the help of state function entropy. Entropy changes in various processes and under various conditions have been discussed.

Chemical bonding (12)

Attainment of stable configuration, Types of bonds ionic, covalent, co-ordinate & metallic, Types of overlaps: s-s, p-p, s-p, p-d, d-d and their examples, Formation of sigma & pi bonds, Theories of bonding- a)valance bond theory, b) Heitler London theory and c) Pauling Slater theory, Concept of hybridization: Definition & need of hybridization, steps involved in hybridization, explanation of covalency of atoms in the moles based on hybridization, types of hybridization involving s, p, & d orbitals.

Applications of hybridization geometries of molecules like

i) BeH_2 ii) BF_3 iii) $[MnCl_4]^{2-}$ iv) $[Ni(CN)_4]^{2-}$ v) $Fe(CO)_5$
vi) $[Cr(H_2O)_6]^{2+}$ vii) IF_7

VSEPR theory: Assumptions, need of theory, application of theory to explain geometry of irregular molecules

i) ClF_3 ii) Cl_2O iii) BrF_5 iii) $TeCl_4$ iv) XeO_3 v) $XeOF_4$

Ref. 12, 13, 14 & 15

Aims and objectives:

Student should understand:

1. Basic principle of overlapping of atomic orbital with specific shapes and sizes
2. Fundamental concepts of theories of overlapping of atomic orbitals
3. Concept of hybridization and differentiation with overlap
4. Concept of different types valence shell electron pairs and their contribution in bonding
5. Application of non-bonded lone pairs in shape of molecule
6. Basic understanding of geometry and effect of lone pairs with examples

References books for Physical Chemistry

1. Physical Chemistry-P.W. Atkins ELBS, 5th edition
2. Principles of Physical Chemistry By S. H. Maron and C. F. Prutton ,4th edition
3. Physical Chemistry by S. Glasstone.
4. Physical Chemistry – Silbey Alberty, Bawendi, Wieley India .
5. Quantum Chemistry – I. Levine, Fifth edition, Prentice Hall-1999
6. Essentials of Physical Chemistry – Bahl, Tuli., S. Chand and Company Ltd.
7. Physical Chemistry of Surfaces – A. W. Adamson, John Wiley and sons , 5th edition.
8. Mathematical preparation of Physical Chemistry by F. Daniel, Mc Graw Hill Publication

PAPER - II: ORGANIC & INORGANIC CHEMISTRY

TERM - I

Chapter1: Chemical Bonding, structure and reactivity of Organic Molecules (14)

Covalent bond, Hybridization - sp, sp^2 and sp^3 hybridization, Bond length, Bond angle, Bond energy, Inter and Intra molecular forces and their effects, Drawing organic molecules, zig-zag structures, Lewis structure and formal charge, Arrow pushing concept, Structural effects - Inductive effect, Steric effect, Resonance effect, Hyper-conjugation, Tautomerism, Applications of structural effects - Strength of acids and bases, pKa and pK_b values of common organic acids and bases.

Ref. 1, 2, 3 & 4

Covalent bond, Hybridization - sp, sp^2 and sp^3 hybridization, Bond length, Bond angle, Bond energy, Inter and Intra molecular forces and their effects
Ref. 2: Pages 9 - 17, 20 - 29
Drawing organic molecules, zig-zag structures, Lewis structure and formal charge
Ref. 1: Pages 31 - 36, 116 - 127
Arrow pushing concept, Structural effects - Inductive effect, Steric effect, Resonance effect, Hyper-conjugation, Tautomerism, Applications of structural effects - Strength of acids and bases, pKa and pK_b values of common organic acids and bases
Ref. 1: Relevant Pages between 181 - 201
Ref. 2: Pages 33 - 35, 200, 406 - 407
Ref. 3: Pages 20 - 28

Aims and Objectives:-

The student is expected to know:

1. The fundamental concepts which govern the structure, bonding, properties and reactivities of organic molecules such as covalent character, hybridization, bond angles, bond energies, bond polarities and shapes of molecules.
2. Drawing of organic molecules and arrow pushing concept.
3. Acid-base theories, pKa / pKb values for common organic acids and bases and factors affecting strength of acids and bases.
4. Structural effects and their applications in determining strength of acids and bases.

Chapter 2: Chemistry of Hydrocarbons (10)

Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions of-Alkanes, alkenes , alkynes and introduction to homocyclic and polycyclic aromatic hydrocarbons (benzene, naphthalene, anthracene), Huckel's rule of aromaticity.

Ref. 1, 2, 3 & 4

Alkanes - Introduction, Nomenclature, Physical properties, Preparations, Reactions of alkanes, Analysis of Alkanes
Ref. 2: Sec. 2.1 – 2.3, Sec. 3.6 – 3.12, Sec. 3.15 – 3.17, Sec. 3.18, 3.19, 3.30, 3.32, Sec. 3.34
Pages: 39 – 41, 86 – 94, 97 – 106, 118, 120, 122
Alkenes - Introduction, higher alkenes, Nomenclature, Physical properties, Preparations, Reactions of alkenes, Analysis of Alkenes
Ref. 2: Sec. 8.7 to 8.9, 8.11 to 8.13, Sec. 9.1, 9.2, 9.27
Pages: 282 – 285, 287 – 293, 309, 317 – 323, 360 - 362

Dienes - Structure & Properties, Conjugated dienes, Reactions of dienes, Analysis of dienes
Ref. 2: Sec. 11.17, 11.19, 11.21, 11.22, 11.26
Pages: 409 – 417, 421, 422

Alkynes: Introduction, Nomenclature, Physical properties, Preparation, Reactions & analysis of alkynes
Ref. 2: Sec. 12.1 - 12.8, 12.14

Pages: 425 – 434, 440

Introduction to homocyclic and polycyclic aromatic hydrocarbons (benzene, naphthalene, anthracene), Huckel's rule of aromaticity, Reactions of benzene, Naphthalene and Anthracene – Sulphonation, Nitration, Halogenation, Friedle Craft reactions

Ref. 2: Sec. 14.1 - 14.5, 14.10, 14.11, 14.12, Relevant pages from 15.1 – 15.21

Pages: 493 – 499, 504, 508 – 511, Relevant pages from 517 - 546

Aims and Objectives:-

The student is expected to know

1. The common and IUPAC names of alkanes, alkenes, alkynes and homocyclic, polycyclic aromatic hydrocarbons.
2. Methods of preparation and chemical reactions of alkanes, alkenes, alkynes and homocyclic, polycyclic aromatic hydrocarbons.
3. Application of Huckel's rule to different organic compounds to find out aromatic /non aromatic characters.
4.

Chapter 3: Chemistry of s-block Elements (12)

Recapitulation of periodic table, special position of hydrogen in the long form of the periodic table, properties of s-block elements w.r.t. electronic configuration, extraction, trends and properties, Introduction to crown ethers and cryptans, separation of s-block elements using crown ethers, Compounds of s-block elements: oxides, hydroxides, peroxides, superoxides, Application of s-block elements in industrial, biological and agricultural fields.

Ref. 6 & 9

Aims and objectives:
Student should learn

1. Skeleton of long form of periodic table
2. Quantum numbers
3. Shells, sub-shells, types of orbital and their shapes
4. Afbau, Paulin's exclusion principle and Hunds rule
5. Block, group, periodic law and periodicity
6. Name, symbol, electronic configuration, trends and properties
7. Crown ether and cryptans
8. Separation of s-block elements with crown ethers
9. Compounds of s-block elements: oxides, hydroxides, peroxides and superoxides
10. Application of s-block elements: Industrial, biological and agricultural field

TERM - II

Chapter 4: Chemistry of functional groups (14)

Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions of: Alkyl halides, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids, amines.

Ref. 1, 2, 3 & 4

Alkyl halides: Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions, Analysis of alkyl halides

Ref. 2: 5.3 – 5.7, 5.24

Pages: 167 – 174, 211

Alcohols: Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions, Analysis of alcohols

Ref. 2: 6.1 – 6.5, 6.10, 6.11, 6.22

Pages: 211 – 218, 222 – 226, 243 – 244

Ethers: Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions, Analysis of ethers

Ref. 2: 6.16 – 6.21, 6.23

Pages: 237 – 242, 244 - 245

Aldehydes and ketones: Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions, Analysis of aldehydes and ketones

Ref. 2: 18.1 – 18.7, 18.20

Pages: 657 – 675, 697

Carboxylic acids: Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions, Analysis of carboxylic acids

Ref. 2: 19.1 – 19.4, 19.6, 19.9, 19.21

Pages: 713 – 722, 725 – 728, 744 - 745

Amines: Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions, Analysis of amines

Ref. 2: 22.1 – 22.5, 22.8, 23.1 – 23.3, 23.12, 23.19

Pages: 821 – 825, 828 – 830, 845 – 849, 866 – 869, 876 - 877

Phenols: Introduction, Nomenclature, Physical properties, General methods for preparation, Chemical reactions, Analysis of phenols

Structure, nomenclature, preparation and reactions of organic compounds.

Ref. 2: 24.1 – 24.3, 24.7, 24.8, 24.16

Pages: 889 – 893, 898 – 902, 912

Aims and Objectives:-

The student is expected to know

1. Structure, nomenclature, preparation and reactions of organic compounds.
2. The characteristic reactions of each functional group which can be used to identify and distinguish that compound from other compounds.
3. Predict the conversion of one functional group into other functional group involving one or more number of steps.
4. Conversion of the given compound into other compound containing more or less number of carbon atoms.
5. Prediction of possible products when reactants are given. In case there are more than one possible products, identify the major and minor products.
6. Suggest the possible reagents to bring about the given conversion.

Chapter 5: Stereochemistry (10)

Concept of isomerism, types of isomers, representation of organic molecules (Projection formulae), conformational isomerism in alkanes (Ethane, propane and n-butane) with energy profile diagrams, Geometrical isomerism - Definition, conditions for geometrical isomers, physical and chemical properties, E/Z nomenclature of geometrical isomers, Optical isomers – Isomer number and tetrahedral carbon atom, chirality, optical isomerism with one asymmetric carbon atom, specific rotation, enantiomerism, R/S nomenclature

Ref. 1, 2, 3, 4, 11 and 12

Ref. 2: Relevant pages from Sec. 3.2 – 3.5, Sec.4.1 – 4.20, Sec. 8.6

Ref. 4: Relevant pages from Sec. 12.1 – 12.2 (Pages 318 – 321)

Ref. 11: Relevant pages from Sec. 1.1 – 1.3, 1.5 – 1.6, 1.8, 1.10 (Pages 1 – 51)

Aims and Objectives:-

The student is expected to know

1. Concept of isomerism, types of isomers and representation of organic molecules.
2. Conformational isomerism in alkanes with energy profile diagram.
3. Concept of geometrical isomerism with E/Z nomenclature.
4. Understanding of optical activity, isomer number, tetrahedral carbon atom, concept of chirality, enantiomerism, R/S nomenclature for single chiral centre.

Ref. 1, 2, 3 & 4

Chapter 6: Chemistry of p-block elements **(12)**

Position of elements in periodic table, electronic configuration of elements trends in properties like atomic size, ionization potential, electronegativity, electron affinity, reactivity, oxidation states, anamolous behaviuor of first member of each group.

Structure and properties of:

1. Borate
2. Halides of aluminum
3. Allotropes of carbon
4. Classification of silicates
5. Oxyacids of phosphorous and sulphur
6. Inter-halogen compounds

Ref. 6 – 359 to 633 (relevant pages)

A student know
i) To write electronic configuration of any element.
ii) To give reasons for anomolous behavior of first element of IIIA to VII A groups with other
elements in the same group.
iii) To know the exact position p-block elements in the long form of the periodic table.
iv) To know the allotropes of carbon.
v) Basic compounds of boron, aluminum, silicon
vi) Concept of oxyanions, different than mineral acids, oxyacids of phosphorous & sulphur
vii) Overlpping of atomic orbitals of halogens, interhalogen compounds

References

1. Organic Chemistry-Clayden, Oxford Uni. Press

2. Organic Chemistry-Morrison and Boyd, 6th Edn.
3. A guide book to Mechanism in Organic Chemistry-Peter Syke, 6th Edn.
4. Stereochemistry of Organic Compounds-Eliel Tata Mc Graw Hill 1989
5. Principles of Physical Chemistry by S.H. Marron & C.F. Pruton, 4th Edn.
6. Concise Inorganic Chemistry-J.D. Lee, 2nd Edition-Relevant pages.
7. Concept & model of Inorganic Chemistry-Douglas Mc Doniels, 3rd Edn.
8. New guide to Modern Valance Theory-G.I. Brown, 3rd Edn.
9. Inorganic Chemistry-James Hughey
10. General Chemistry - Raymand Chang

F.Y.B. Sc.

Chemistry Paper - III

Practical Course

1. Physical Chemistry : 7 experiments
2. Inorganic Chemistry: 7 experiments
3. Organic Chemistry : 7 experiments

Physical Chemistry (minimum 7 experiments)

1. A) Preparation of lyphophyllic and lypophobic sols, B) purification of prepared sols by hydrolysis
2. To study the role of emulsifying agents in stabilizing the emulsion of different oils
3. Sketch the polar plots of s and p orbitals.
4. Plot the graph of following functions using excel a) exponential function b) logarithmic function c) linear functions
5. To determine the gas constant R in different units by eudiometer method.
6. To determine relative viscosity of given organic liquids by viscometer. (four liquids)
7. Investigate the adsorption of acetic acid by activated charcoal and test the validity of Freundlich /Langmuir adsorption isotherm.
8. To determine ΔH and ΔS for the following chemical reactions

   i) $Zn(s) + CuSO_4\ (aq) \rightarrow Cu(s) + ZnSO_4\ (aq)$

   ii) $3Mg(s) + 2FeCl_3\ (aq) \rightarrow 2Fe(s) + 3MgCl_2\ (aq)$

Inorganic Chemistry (minimum 7 experiments)

A. Compulsory experiments

9. Determination of hardness of water from a given sample of water by EDTA method.
10. Analysis of alkali mixture by volumetric method.

B. Any Three Inorganic qualitative analyses without phosphate and borate removal.

11) Mixture-1 (water soluble)

12) Mixture-2 (water insoluble)

13) Mixture-3 (water insoluble)

C-Any one of the following

14) To standardize NaOH solution & hence find the strength of given HCl solution.

15)To standardize $KMnO_4$ soln. & hence find strength of the given solution

D Any One of the following:

16) Estimation of % purity of a given sample of sodium chloride.

17) Analysis of brass

Organic Chemistry (Minimum 7 experiments)

18. Techniques (**any two**) - To be carried out on micro-scale
    i. Thin layer chromatography
    ii. Crystallization with M.P. and % yield of purified compound
    iii. Distillation with B.P. and % yield of purified compound
    iv. Sublimation with M.P. and % yield of purified compound
19. Estimations (**any one**)
    i. To determine amount of acetic acid in commercial vinegar
    ii. To determine amount of aspirin in APC tablets
20. Organic qualitative analysis of single organic compound at least one belonging from each type (**any four**)

    Type, Preliminary tests, elements, functional group, physical constants

    a. Benzoic acid, Salicylic acid, Cinnamic acid, Phthalic acid, oxalic acid
    b. β-Naphthol, α-naphthol
    c. Aniline, N,N-Dimethyl aniline
    d. Napthalene, Thiourea, Urea, m-Dinitrobenzene, chloroform, ethyl methyl ketone, ethyl acetate, chlorobenzene

Pattern for F.Y.B.Sc. Practical Examination

Sr. No.	Experiment	Marks
1	Physical chemistry OR Inorganic Volumetric OR Organic Estimation	35
2	Inorganic Qualitative Analysis OR Organic Qualitative Analysis and Technique	35
3	Oral	10
4	Internal marks for Journal and Oral	20

Note:-

1. At the time of Practical examination in a batch 50 % students must be given Physical Experiments.
3. For Organic Qualitative Analysis 20 marks & for technique 15 marks.
4. For Volumetric Analysis students must prepare standard solutions.
5. External printed material or practical book/ text book is allowed during the practical examination.

UNIVERSITY OF PUNE, PUNE.

Syllabus for F.Y.B.Sc

Subject: MATHEMATICS

(With effect from June 2013)

Introduction:

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

Aims:

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

Objectives:

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

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

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

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

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

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

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

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

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

Equivalence of Previous syllabus along with new syllabus:

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

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

Details of Syllabus:

MT 101: Algebra &Geometry

FIRST TERM (Algebra)

Unit 01: Integers **15 Lectures**

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

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

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

Unit 02: Polynomials **6 Lectures**

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

2.2 Remainder Theorem, Factor Theorem.

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

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

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

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

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

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

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

SECOND TERM (Geometry)

Unit 04: Analytical Geometry of two dimensions: 10 Lectures

4.1) Change of axes, Translation and rotation.

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

Unit 05: Planes in 3-dimension: 6 Lectures

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

5.1 Systems of planes, two sides of a plane.

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

5.3 Joint equation of two planes, Angle between planes.

Unit 06: Lines in 3-dimension: 6 Lectures

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

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

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

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

Unit 07: Sphere 8 Lectures

7.1 Definition and equation of the sphere in various forms.

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

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

7.4 Equation of a tangent plane.

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

8.1 Definition of cone and cylinder.

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

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

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

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

Reference Books:

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

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MT 102: Calculus and Differential Equations

FIRST TERM (Calculus)

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

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

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

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

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

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

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

2.3 Continuous functions on intervals.

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

Unit 3. Differentiation **18Lectures**

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

3.2 Differentiability of a function over an interval.

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

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

3.5 Indeterminate forms. L-Hospitals rule.

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

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

SECOND TERM
(Differential Equations)

Unit 4. Integration **08 Lectures**

4.1 Integration of rational function by using partial fraction.

4.2 Integration of some irrational functions:

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

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

4.3 Reduction formula

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

$iv)\int_0^{\pi/2}sin^nxdx\ \ \ v)\int_0^{\pi/2}cos^nxdx$

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

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

5.2 Differential equations, General solution of Differential equations.

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

Unit 6. Application of Differential Equations : 06 Lectures

6.1 Orthogonal trajectories.

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

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

7.1 Equations solvable for p.

7.2 Equations solvable for x.

7.3 Equations solvable for y.

7.4 Equation in Clairaut's form.

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

Reference Books:

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

Third Edition, John Wiley and Sons, 2002

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

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

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

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

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

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

Company,2009.

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MT 103: Mathematics Practical

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

List of Practicals:

TERM I

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

TERM II

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

Modalities For Conducting The Practical and The Practical Examination

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

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

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

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

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

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

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

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

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

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

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

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

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

University of Pune

Three Year B. Sc. Degree Course in

MICROBIOLOGY

Syllabus

(To be implemented from Academic Year 2013-14)

Preamble:

Microbiology is a branch of science that studies “Life” taking an example of microorganisms such as bacteria, protozoa, algae, fungi, bacteria, viruses, etc. These studies integrate cytology, physiology, ecology, genetics and molecular biology, evolution, taxonomy and systematics with a focus on microorganisms; in particular bacteria. The relevance and applications of these microorganisms to the surrounding environment including human life and Mother Nature becomes part of this branch. Since inception of this branch of science, Microbiology has remained a field of actively research and ever expanding in all possible directions; broadly categorized as pure and applied science. Different branches of Pure Microbiology based on taxonomy are Bacteriology, Mycology, Protozoology and Parasitology, Phycology and Virology; with considerable overlap between these specific branches over each other and also with other disciplines of life sciences, like Biochemistry, Botany, Zoology, Cell Biology, Biotechnology, Nanotechnology, Bioinformatics, etc. Areas in the applied Microbial Sciences can be identified as: Medical, Pharmaceutical, Industrial (Fermentation, Pollution Control), Air, Water, Food and Dairy, Agriculture (Plant Pathology and Soil Microbiology), Veterinary, Environmental (Ecology, Geomicrobiology); and the technological aspects of these areas.

Knowledge of different aspects of Microbiology has become crucial and indispensable to everyone in the society. Study of microbes has become an integral part of education and human progress. Building a foundation and a sound knowledge-base of Microbiological principles among the future citizens of the country will lead to an educated, intellectual and scientifically advanced society. Microbiological tools have been extensively used to study different life processes and are cutting edge technologies. There is a continual demand for microbiologists in the work force – education, industry and research. Career opportunities for the graduate students are available in manufacturing industry and research institutes at technical level.

Introduction:

The syllabi till today had been sufficient to cater for the needs of students for building up their careers in industry and research. However, with the changing scenario at local and global level, we feel that the syllabus orientation should be altered to keep pace with developments in the education sector. The need of the hour is proper syllabi that emphasize on teaching of technological as well as the administrative aspects of modern biology. Theory supplemented with extensive laboratory expertise will help these students, to avail these opportunities. Both these aspects i.e. theory and more of practical needs to stressed, such that a graduate student can start work directly in applied fields (industry or institutions), without any additional training.

Thus, the university / college itself will be developing the trained and skilled man-power. We even find a lack of trained teachers who can share their experiences on different aspects in microbiology. And we plan to restructure the syllabus in this viewpoint. The restructured syllabus will combine the principles of chemistry and biological sciences (molecular and cell biology, genetics, immunology and analytical tools) with technological disciplines to produce goods and services and for environmental management.

Microbiology curricula are operated 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 particularly in day-to-day applications of Microbiology 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

Eligibility

1. 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)

2. Second Year B.Sc.:

Keeping terms of First Year of B. Sc. with Microbiology as one of the subjects. In addition to the above qualification students who have passed the Diploma course in Pharmacy are eligible however such cases should be approved by equivalence committee of Faculty of Science of the University of Pune.

3. Third Year B. Sc.:

Student shall clear all First Year B. Sc. Microbiology courses and satisfactorily keeping terms of Second Year of B. Sc. with Microbiology as one of the subjects.

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.

Standard of Passing

i. In order to pass in the first year theory examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks must be obtained in the University Theory Examination.)

ii. In order to pass in the Second Year and Third Year theory examination, the candidate has to obtain 20 marks out of 50 in each course of each semester. (Minimum 16 marks must be obtained in the University Theory Examination.)
iii. In order to pass in practical examination, the candidate has to obtain 40 marks out of 100 in each course. (Minimum 32 marks must be obtained in the University Examination.)

Award of Class

The class will be awarded to the student on the aggregate marks obtained during the second and third year in the Principle subject only. The award of the class shall be as follows:

1	Aggregate 70% and above	First Class with Distinction
2	Aggregate 60% and more but less than 70%	First Class
3	Aggregate 55% and more but less than 60%	Higher Second Class
4	Aggregate 50% and more but less than 55%	Second Class
5	Aggregate 40% and more but less than 50%	Pass Class
6	Below 40%	Fail

ATKT Rules

While going from F. Y. B. Sc. to S. Y. B. Sc. at least 8 courses (out of total 12) should be cleared; however all F. Y. B. Sc. courses should be cleared while going to T. Y. B. Sc.

While going from S. Y. B. Sc. to T. Y. B. Sc., at least 12 courses (out of 20) should be cleared (Practical Course at S. Y. B. Sc. will be equivalent to 2 courses).

Equivalence of Previous Syllabus

No equivalence required at F. Y. B. Sc. level, the course titles are same as previous syllabus.

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.

Course Structure:

Duration: The duration of B.Sc. (Microbiology) Degree Program shall be three years.

Medium of Instruction: The medium of instruction for the course shall be English.

To accommodate more advanced topics in the syllabi, it is necessary to understand the base 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 repetitions of introductory cell biology.

At **first year of under-graduation**, students will be given 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 for 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 log books.

At **second year under-graduation**, principles of taxonomy and classification of major groups of microorganisms can be studied in one of the papers. This 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 regards to pollution and biodegradation; water and sewage treatment. Practical for the second year students will be less defined i.e. kept more flexible, designed to evolve project themes on environment, agriculture and pollution aspects and acquiring laboratory related skills. Practical at this level will also include application of biostatistics principles and computers for data analysis and interpretation, and introduction to scientific writing and report preparation. These aspects can be practiced better while carrying out the mini-projects.

At **third year under-graduation**, six theory papers deal with broad applied areas of microbiology that are interactive with higher living forms. Five such areas are – medical microbiology, microbial physiology, microbial (prokaryotic and eukaryotic) genetics, immunology and immunopathology, fermentation technology. The sixth course will be Applied Microbiology that will include – Dairy Microbiology, Food Microbiology, Fermentation Technology, Agriculture Biotechnology, Fungal Biotechnology, etc. The practical at third year will be planed more intensively, with exposure to applied fields.

F. Y. B. Sc. Microbiology

Paper	Course Title	Marks	Lectures
Paper - I	Introduction to Microbiology	100	Three Periods/Week per Paper (Total 36/Paper per Term)
Paper - II	Basic Techniques in Microbiology	100	
Practical Course	Practical Course	100	*Four Hours / Week (Total 96 – Term I & II)
***Practical to be conducted as two hours each day on two consecutive days / Batch**			

Examination Pattern

Theory paper:	University Examination	– 80 marks (at the end 2nd term)
	Internal Examination	– 20 marks
Practical course:	University Examination	– 80 marks (at the end of 2nd term)
	Internal Examination	– 20 marks

Theory examination will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	8 sub-questions, each of 2 marks; answerable in 2 -3 line and based on entire syllabus
Question 2 and 3	4 out of 6– short answer type questions; answerable in 6 – 8 lines
Question 4	2 out of 4 – long answer type questions; answerable in 12 – 16 lines
Question 5	1 out of 2 –essay / long answer type question; answerable in 25 – 30 lines

Internal examination: Internal assessment of the student by respective teacher will be comprehensive and continuous, based on written test, 10 marks each term. The written test shall comprise of objective type questions – Multiple Types Questions, True / False, Definitions, Tricky computational problems with minimum calculations. There shall be 20 questions, each question of 0.5 marks.

Practical Examination: Practical examination shall be conducted by the respective college at the end of the academic year. Practical examination will be of minimum 4 hours duration, carried over on two subsequent days. There shall be 10 marks for laboratory log book and journal, 10 marks for viva-voce and minimum three experiments. Certified journal is compulsory to appear for practical examination. There shall be two experts and two examiners per batch for the practical examination.

Setting question papers: Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject.

S. Y. B. Sc. Microbiology

	Paper	Course Title	Marks	Lectures
Semester I	MB - 211	Bacterial Systematics and Physiology	50	Four Periods/Week per Paper (Total 48/Paper per Semester)
	MB - 212	Microbial Genetics	50	
Semester II	MB – 221	Analytical Microbiology	50	
	MB - 222	Air and Water Microbiology	50	
Semester I & II	Practical Course	Practical Course	100	***Four Hours / Week (Total 96 – Semester I & II)
***Practical to be conducted as two hours each day on two consecutive days / Batch**				

Examination Pattern

Theory paper: University Examination – 40 marks (at the end of each semester)
Internal Examination – 10 marks
Practical course: University Examination – 80 marks (at the end of 2nd semester)
Internal Examination – 20 marks

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	10 sub-questions, each of 1 marks; objective type and based on entire syllabus
Question 2 and 3	2 out of 3 sub-questions, each of 5 marks; short answer type questions; answerable in 10 – 15 lines
Question 4	1 out of 2 – long answer type questions; answerable in 20 – 25 lines

Internal examination: Internal assessment of the student by respective teacher will be comprehensive and continuous, based on written test, 10 marks each semester. The written test shall comprise of objective type questions – Multiple Types Questions, True / False, Definitions, Tricky computational problems with minimum calculations. Different sets of question papers may be given in the same class-room. There shall be 20 questions to be answered in 40 minutes, each question of 1mark.

Practical Examination: Practical examination will be of minimum 4 hours duration, carried over on two subsequent days. There shall be 10 marks for laboratory log book and journal, 10 marks for viva-voce and minimum three experiments. Certified journal is compulsory for appearing for practical examination. There shall be two experts and two examiners per batch for the practical examination. One of the examiners will be external.

Setting question papers: Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject.

T. Y. B. Sc. Microbiology

Theory Papers

	Paper	Paper Title	Marks	Lecturers
Semester III	MB 331	Medical Microbiology – I	50	Four Periods/Week per Paper (Total 48/Paper per Semester)
	MB 332	Genetics & Molecular Biology - I	50	
	MB 333	Enzymology	50	
	MB 334	Immunology -I	50	
	MB 335	Fermentation Technology -I	50	
	MB 336	Applied Microbiology - I	50	
Semester IV	MB 341	Medical Microbiology - II	50	
	MB 342	Genetics & Molecular Biology - II	50	
	MB 343	Metabolism	50	
	MB 344	Immunology -II	50	
	MB 345	Fermentation Technology -II	50	
	MB 346	Applied Microbiology - II	50	

Practical Courses

	Course	Course title	Marks	
Semester III & IV	MB 347	Practical course – I Applied Microbiology	100	***Four Hours / Week per course (Total 96/Course per Semester)**
	MB 348	Practical course – II Biochemistry & Molecular Biology	100	
	MB 349	Practical course – III Diagnostic Microbiology & Immunology	100	
***Practical to be conducted as four hours each day on three consecutive days / Batch**				

Examination Pattern

Theory paper: University Examination – 40 marks (at the end of each semester)
Internal Examination – 10 marks
Practical course: University Examination – 80 marks (at the end of 2nd semester)
Internal Examination – 20 marks

Theory examination will be of two hours duration for each theory course. There shall be 4 questions each carrying equal marks. The pattern of question papers shall be:

Question 1	10 sub-questions, each of 1 marks; objective type and based on entire syllabus
Question 2 and 3	2 out of 3 sub-questions, each of 5 marks; short answer type questions; answerable in 10 – 15 lines
Question 4	1 out of 2 – long answer type questions; answerable in 20 – 25 lines

Internal examination: Internal assessment of the student by respective teacher will be comprehensive and continuous, based on written test, 10 marks each semester. The written test shall comprise of objective type questions – Multiple Types Questions, True / False, Definitions, Tricky computational problems with minimum calculations. Different sets of question papers may

be given in the same class-room. There shall be 20 questions to be answered in 40 minutes, each question of 1mark.

Practical Examination: Practical examination will be of minimum 6 hours duration, carried over on three subsequent days. There shall be 10 marks for laboratory log book and journal, 10 marks for viva-voce and minimum three experiments per practical course. Certified journals are compulsory for appearing for practical examination. There shall be two experts for each practical course and two examiners per batch; one of the examiners will be external.

Setting question papers: Questions should be designed to test the conceptual knowledge and understanding of the basic concepts of the subject.

Qualification of Teachers:

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

F. Y. B. Sc. Microbiology

Theory Paper I: Introduction To Microbiology

Paper I: Term I

Sr. No.	Topic	Lectures
1.	**Frontiers of Microbiology**	**2**
2.	**A. History of Microbiology** I. Discovery of microscope II. Micrographia of Anton von Leeuwenhoek and Robert Hooke III. Abiogenesis v/s biogenesis • Aristotle's notion about spontaneous generation • Redi's experiment • Louis Pasteur's & Tyndall's experiments	**6**
	B. Development of Microbiology in 19th century I. Observations and role of microorganisms in transformation of organic matter. • Germ theory of fermentation • Discovery of anaerobic life & physiological significance of fermentation II. Discovery of microbes as pathogens • Surgical antisepsis • Germ theory of disease – Koch's postulates & River's postulates	**4** **4**
	C. Developments in 20th and 21st Centuries with respect to: • Vaccination and Chemotherapy • Contributions of Nobel Laureates in Immunology, Molecular Biology & Biotechnology	**4**
3.	**Morphological and differentiating characters of microorganisms:** • Bacteria • Rickettsia • Protozoa • Algae • Fungi (Molds and Yeasts) • Viruses, viroids and prions Principles in classification of Bacteria (Introduction to Bergey's Manual of Determinative and Systemic Bacteriology) and viruses (ICTV)	**12**
4.	**Applications of Microbiology:** i. Significance of normal flora and probiotics in human health ii. Microbes as Biofertilizers and Biocontrol Agents (e.g. Nitrogen fixers, Phosphate Solubilizers and *Bacillus thuringensis*)	**4**

Paper I: Term II

Sr. No.	Topic	Lectures
5.	**I.** Covalent and non-covalent bonding in biomolecules **II.** Concepts of pH and redox potential	4
	Chemistry of Biomolecules • Carbohydrates (Starch, Glycogen, Cellulose, Peptidoglycan) • Lipids (Triglycerides and phospholipids) • Structural and Functional Proteins (Hemoglobin, Immunoglobulin; flagellin and cytoskeletal proteins in bacterial cell) • Nucleic acids (DNA and RNA)	16
6.	**Bacterial Cytology** Studies on structure, chemical composition and functions of the following components in bacterial cell: • Cell wall • Cell membrane • Endospore • Capsule • Flagella • Fimbriae and Pili • Ribosomes • Chromosomal & extra-chromosomal material • Cell inclusions (Gas vesicles, carboxysomes, PHB granules, metachromatic granules and glycogen bodies)	16

THEORY PAPER II: BASIC TECHNIQUES IN MICROBIOLOGY

Paper II: Term I

Sr. No.	Topic	Lectures
1.	a. Units of measurement. Modern SI units (Length, volume, Weight) b. Microscopy : • Bright field microscopy: 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, eye-pieces and objectives • Aberrations in lenses - spherical, chromatic, comma and astigmatism • Principles, construction, working and applications of: i. Dark field microscopy ii. Fluorescence microscopy • Confocal microscopy	12

2.	Staining Techniques : • Definitions of Stain; Types of stains (Basic and Acidic), • Properties and role of Fixatives, Mordants, Decolorisers and Accentuators • Principles of staining techniques for following: i. Monochrome staining and Negative (Relief) staining ii. Differential staining - Gram staining and Acid fast staining	**8**
3.	Sterilization and Disinfection	
	1. Physical Agents - Heat, Radiation, Filtration	**6**
	2. Chemical agents and their mode of action - Aldehydes, Halogens, Quaternary ammonium compounds, Phenol and phenolic compounds, Heavy metals, Alcohol, Dyes, Detergents and Ethylene oxide. 3. Characteristics of an ideal disinfectant 4. Checking of Efficiency of Sterilization – Biological and Chemical Indicators 5. 5. Checking of Efficiency of Disinfection - Phenol Coefficient	**10**

Paper II: Term II

Sr. No.	Topic	Lectures
4.	**Cultivation of Microorganisms**	
	1. Nutritional requirements and nutritional classification	**3**
	2. Design and preparation of media – Common ingredients of media and types of media	**3**
	3. Methods for cultivating photosynthetic, extremophilic and chemolithotrophic bacteria.	**4**
	4. Concept of Pure Culture, Enrichment, Isolation and Preservation techniques. Maintenance of bacterial and fungal cultures	**6**
	5. Culture collection centers and their role. Requirements and guidelines of National Biodiversity Board for Culture collection centers	**2**
5.	**Bacterial Growth**	
	Growth Kinetics and growth curve; definitions of Generation time, Growth rate and specific growth rate	**4**
	Methods of enumeration: 1. Microscopic methods (Direct Microscopic Count, Counting cells using Neubauer, Petroff and Hausser's chambers) 2. Plate counts (Total Viable Count) 3. Estimation of Biomass (Dry mass, Cell volume) 4. Chemical methods (Cell Carbon and Nitrogen estimation) 5. Turbidometric methods (Nephalometry)	**6**
	Factors affecting bacterial growth (pH, Temperature, Solute Concentration (Salt and Sugar) and Heavy metals	**4**
	Diauxic growth	**1**
	Synchronous culture	**3**

Practical Course
(Term I & II)

BASED ON THEORY PAPER I & II		**(96)**
Expt. No.	**Topic**	**Hours**
1-2	Preparation of Standard Operating Procedures (SOPs) for common microbiology laboratory instruments e.g. Incubator, Hot Air Oven, Autoclave, Colorimeter, pH Meter, Distillation Unit, Chemical Balance, Laminar air flow hood, Clinical Centrifuge	**2**
3	Construction (mechanical and optical), working and care of bright field microscope	**1**
4	Observation of microorganisms using bright field microscope - Bacteria, Protozoa, Molds and Yeasts, Algae – from natural habitat	**1**
5-7	Observation of microorganisms using staining techniques: a. Monochrome staining and b. Negative /Relief staining (Capsule staining) c. Gram staining of bacteria	**3**
8-9	Observation of motility in bacteria using: a. Hanging drop method and Cragie's tube method b. Swarming growth methods	**2**
10	Enumeration of yeast cells using a counting chamber	**1**
11-12	Cultivation of microorganisms: a. Preparation of simple laboratory nutrient media (solid and liquid) and using them to cultivate bacteria. b. Observation of the growth of cultures and reporting of colony and cultural characteristics (Nutrient and MacConkey's agar)	**2**
13	Isolation of bacteria by streak plate technique	**1**
14-15	Enumeration of bacteria from fermented food / soil / water by: a. Spread plate method b. Pour plate method	**2**
16	Aseptic transfer techniques (slant to slant, broth to broth, broth to agar and Agar to Agar)	**1**
17	Preservation of cultures on slants, soil and on grain surfaces; revival of these cultures and lyophilized cultures.	**1**
18	Checking sterilization efficiency of autoclave using a biological indicator (*B. stearothermophilus*)	**1**
19	Demonstration of checking of efficacy of chemical disinfectant: Phenol Coefficient Rideal Walker method)	**1**
20	Preparation of Winogradsky column and observation of different types of microorganisms using bright filed microscope.	**1**
21-22	Study of normal flora of skin: a. Cultivating and observing different morphoforms of bacteria from skin b. Study of effect of washing skin with soap and disinfectant on it's microflora	**2**
23-24	a. To study the effect of different parameters on growth of *E. coli*: pH, temperature, sodium chloride concentration b. Study of Oligodynamic action of heavy metal	**2**

Recommended Books:

1. Daniel Lim, Microbiology, 2nd Edition; McGraw-Hill Publication
2. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3nd Edition. Thomson Brooks / Cole.
3. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.
5. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.
6. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education
7. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8th Edition, McGraw-Hill Higher Education
8. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.
9. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
10. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc
11. Wilson K. and Walker J.M. (2005) Principles and Techniques of Biochemistry and Molecular Biology. 6th Edition. Cambridge University Press.
12. Hans G. Schlegel (1993) General Microbiology, 8th Edition, Cambridge University Press
13. David T. Plummer (1993) An Introduction To Practical Biochemistry, 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi

Faculty of Science

Revised Syllabus

For

B. Sc.
(Physics)

From Academic Year 2013-2014

Structure of Syllabus

UNIVERSITY OF PUNE

Proposed Structure of B.Sc. (Physics) Syllabus

1) Preamble:

The systematic and planned curricula from first year to the third year shall motivate and encourage the students for pursuing higher studies in Physics and for becoming an entrepreneur.

Objectives:

- To provide in depth knowledge of scientific and technological aspects of Physics
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving, hand on activities, study visits, projects etc.
- To train students in skills related to research, education, industry, and market.
- To create foundation for research and development in Electronics
- To develop analytical abilities towards real world problems
- To help students build-up a progressive and successful career in Physics

2) Eligibility:

1 **First Year B.Sc.:** Higher Secondary School Certificate (10+2) Science stream or its equivalent Examination as per the University of Pune eligibility norms.

2 **Second Year B.Sc.:** Keeping terms of First Year of B. Sc. with Physics as one of the subjects. Other students if they fulfil the conditions approved by the equivalence committee of Faculty of Science of the University of Pune are also eligible.

3 **Third Year B. Sc.:** Student shall pass all First Year B. Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Physics as one of the subjects.

Note: Admissions will be given as per the selection procedure / policies adopted by the respective college, in accordance with conditions laid down by the University of Pune. Reservation and relaxation will be as per the Government rules.

F.Y. B. Sc.
(From Academic Year 2013-2014)
(To be implemented from Academic Year 2013-14

Paper	Title
Paper I	Section I (For Term 1): Mechanics
	Section II (For Term 2): Heat and Thermodynamics
Paper II	Section I (For Term 1): Physics Principles and Applications
	Section II (For Term 2): Electromagnetics
Paper III	(For Term1 and Term 2): Practical

For each theory course: 36 Lectures per term/2 Credits per term

For practical course: 20 practicals/4Credits

S. Y. B. Sc.
(Semester Pattern)
(From Academic Year 2014-2015)

Semester I

Paper	Title
Paper I (PHY211)	Mathematical Methods in Physics I
Paper II (PHY 212)	Electronics I /Instrumentation

Semester II

Paper	Title
Paper I (PHY221)	Oscillations, Waves and Sound
Paper II (PHY 222)	Optics

Practical Course (Annual)

Paper III (PHY 223) (Annual)	Practical

T. Y. B. Sc. (Physics)
(Semester Pattern)

(From Academic Year 2015-2016)

Theory Courses (Semester)	
Semester III	**Semester IV**
PH331: Mathematical Methods in Physics II	PH341: Solid State Physics
PH332: Classical Electrodynamics	PH342: Quantum Mechanics
PH333: Classical Mechanics	PH343: Thermodynamics and Statistical Physics
PH334: Atomic and Molecular Physics	PH344: Nuclear Physics
PH335: Computational Physics	PH345: Electronics II /Advanced Electronics

PH336: Elective I (Select any One)	PH346: Elective II (Select any One)
A: Astronomy and Astrophysics	F: Renewable Energy Sources
B: Elements of Materials Science	G: Physics of Nano materials
C: Motion Picture Physics	H: Microcontrollers
D: Biophysics	I: Electro Acoustics and Entertainment Electronics
E: Medical Electronics	J: Lasers
	K: Methods of Experimental Physics
Practical Courses (Annual)	
PH347: Laboratory Course I	
Phy348: Laboratory Course II	
PH349: Laboratory Course III (Project)	

Examination:

A) Pattern of Examination:

i) F. Y. B. Sc.

(a) There shall be university examination at the end of the academic year for 80 marks for each theory paper.

(b) 20 marks for each paper are allotted to the comprehensive internal assessment of the student by the respective teacher, teaching the course. The teacher shall evaluate the performance of the student for 10 marks in each term; on the basis of written tests. Ordinarily written tests shall consist of (i) multiple choice questions, (ii) True/False, (iii) basic definitions, (iv) tricky computational problems involving minimal calculations. Student is asked to answer 20 questions in 40 minutes. Each question will be of ½ marks. In the same classroom setup, different set of equivalent sets of question papers may be experimented. It will be preferred to have two such tests in each term, per course(one at the middle of the term and one at the end of the term) and average (or best of the two tests) be considered as internal marks out of 10 for that term. Internal Test shall cover the entire syllabus. If teacher prefers to have one test only, it shall be at the end of the term covering the entire syllabus).

(c) Practical examination be conducted by respective colleges at the end of the academic year 80 marks be assigned to practicals and 20 marks for internal examination, journal attendance (Journal 10 marks, Oral 10 marks).

ii) S. Y. B. Sc. and T. Y. B. Sc.

(a) There shall be university examination at the end of semester for 40 marks for each theory paper.

(b) 10 marks for each paper are allotted to the comprehensive internal assessment of the student by the respective teacher, teaching the course. Pattern of internal assessment shall be on the lines of F.Y.B. Sc.

(c) University Practical examination be conducted at the end of the academic year 80 marks be assigned to practicals and 20 marks for internal examination, journal attendance (Journal 10 marks, Oral 10 marks).

For practical examination:

(1) At least one examiner should be external

(2) Certified journals be compulsory

(3) There shall be two experts for all subjects.

(4) (a) At T. Y. B. Sc. level, it is preferred to have project work in lien of one of the practical course.

(b) Blue print for Model Question Paper: Each Board of Studies shall frame at least 5 sets of model theory papers and 10 sets of model question set for internal assessment.

II) Pattern of the Question paper:

For theory paper (University examination) shall be as follows.

F. Y. B. Sc. (80 Marks) (Time Allotted: 3 hrs)

Q1. 16 marks for 8 sub-questions, each sub-question for two marks. Sub-questions shall be answerable in two to four lines and shall be based on complete syllabus.

Q2. and Q3. Student shall attempt four out of six questions. Each short answer type question shall carry four marks and be answerable in 6 to 8 lines.

Q4. Student shall attempt 2 out of 4 long answer type questions. Each question will be for 8 marks and be answerable in 12 to 16 lines.

Q5. Long easy type question for 16 marks. Student shall attempt one out of two questions.

OR

Q5. Shall be on the pattern of question 4.

(Question paper of a particular course should contain minimum of 30% weightage to problems)

S. Y. B. Sc. and T. Y. B. Sc. (Theory) University Question Paper Pattern:

(40 marks, Time allotted: 2 hrs)

Q1. 10 sub-question each for 1 mark. Sub-questions be answerable within 2 to 4 lines and shall be based on complete syllabus. All sub-questions are compulsory.

Q2 and Q3: (10 Marks for each questions) Three sub questions. Students have to attempt any two questions.

Q4. Long Essay type question for 8 marks and one question of two marks.

B) Standard of Passing: 40 % marks

C) ATKT Rules

(i) Students shall clear 8 heads of passing (out of 12 such heads) while going from F. Y. B. Sc. to S.Y.B.Sc. However he must pass in all F. Y. B. Sc. subjects while going to T. Y. B. Sc.

(ii) Student shall clear 12 heads of passing (out of 20 such heads) while going from S. Y. B. Sc. to T. Y. B. Sc. (Practical course of S. Y. B. Sc. will be equivalent to 2 heads of passing)

D) Award of Class: As per University norms.

E) External Students: Not applicable

F) Setting of question paper/Pattern of Question paper: As mentioned above

6) Structure of the Course:

a) Compulsory paper: a) At F.Y.B.Sc. and S.Y.B.Sc. all papers are compulsory and at T.Y.B.Sc. 8 papers are compulsory and one paper is optional.

b) Optional papers: At T.Y.B.Sc. one paper per semester is optional.

c) Question papers and papers etc.: As mentioned above

d) Medium of Instructions: English

7) Equivalence of previous syllabus along with propose syllabus: The papers are similar so no equivalence is required at B. Sc. level.

8) University terms: 6 terms

9) Subject-wise detailed syllabus: Attached with this format.

10) Recommended books: Given in the syllabus at the end of each course.

11) Qualification of teachers: As per UGC regulations.

F. Y. B. Sc.
Term -I

Physics Paper I: Section I: Mechanics

Lectures: 36 **Credits: 2**

Learning Outcomes:

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

1. Demonstrate an understanding of Newton's laws and applying them in calculations of the motion of simple systems.
2. Use the free body diagrams to analyse the forces on the object.
3. Understand the concepts of energy, work, power, the concepts of conservation of energy and be able to perform calculations using them.
4. Understand the concepts of elasticity and be able to perform calculations using them.
5. Understand the concepts of surface tension and viscosity and be able to perform calculations using them.
6. Use of Bernoulli's theorem in real life problems.
7. Demonstrate quantitative problem solving skills in all the topics covered.

Syllabus:

1. Newton's laws of motion **(6 Lectures)**

1.1 Newton's First and Second Law and their explanation
1.2 Working with Newton's First and Second Law
1.3 Newton's Third Law of motion and its explanation
1.4 Various types of forces in nature (explanation) and concept of field
1.5 Frame of reference (Inertial, Non-inertial)
1.6 Pseudo Forces (e.g. Centrifugal Force)

2. Work and Energy **(8 Lectures)**

2.1 Kinetic Energy
2.2 Work and Work-Energy Theorem
2.3 Calculation of Work done with
i) Constant Force
ii) Variable Force
Illustration
2.4 Conservative and Non-conservative Forces
2.5 Potential energy and conservation of Mechanical energy
2.6 Change in potential energy in rigid body motion
Mass-energy equivalence

3. Elasticity **(8 Lectures)**

3.1 Hook's law and coefficient of elasticity
3.2 Young's modulus, Bulk modulus and Modulus of rigidity
3.3 Work done during longitudinal strain, volume strain, and shearing strain
3.4 Poisson's ratio
3.5 Relation between three elastic moduli (Y, η, K)
3.6 Determination of Y of rectangular thin bar loaded at the centre
3.7 Torsional oscillations
Torsional rigidity of a wire, to determine η by torsional oscillations

4. Surface Tension **(5 Lectures)**

4.1 Surface Tension, Angle of Contact, Capillary Rise Method
4.2 Rise of liquid in a conical capillary tube
4.3 Energy required to raise a liquid in capillary tube

4.4 Factors affecting surface tension
4.5 Jeager's Method for Determination of surface tension
4.6 Applications of Surface Tension

5. Viscosity and Fluid Mechanics (9 Lectures)

5.1 Concept of Viscous Forces and Viscosity
5.2 Pressure in a fluid and buoyancy
5.3 Pascal's law
5.4 Atmospheric Pressure and Barometer
5.5 Pressure difference and Buoyant Force in accelerating fluids
5.6 Steady and Turbulent Flow, Reynolds's number
5.8 Equation of continuity
5.9 Bernoulli's Principle
5.10 Application of Bernoulli's equation
i) Speed of Efflux
ii) Ventury meter
iii) Aspirator Pump
iv) Change of plane of motion of a spinning ball.

Reference Books:

1. University Physics: Sears and Zeemansky, XIth edition, Pearson education
2. Concepts of Physics: H.C. Varma, Bharati Bhavan Publishers
3. Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd.
4. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir, VI Edition, Pearson Education/Prentice Hall International, New Delhi
5. Properties of Matter: D. S. Mathur, Shamlal Chritable Trust New Delhi
6. Mechanics: D.S Mathur, S Chand and Company New Delhi-5.

F. Y. B. Sc.
Term –II

Physics Paper I: Section II: Heat and Thermodynamics

Lectures: 36 **Credits: 2**

Learning Outcomes:

After successfully completing this course, the student will be able to do the following:

1. Describe the properties of and relationships between the thermodynamic properties of a pure substance.
2. Describe the ideal gas equation and its limitations.
3. Describe the real gas equation.
4. Apply the laws of thermodynamics to formulate the relations necessary to analyze a thermodynamic process.
5. Analyse the heat engines and calculate thermal efficiency.
6. Analyze the refrigerators, heat pumps and calculate coefficient of performance.
7. Understand property 'entropy' and derive some thermo dynamical relations using entropy concept.
8. Understand the types of thermometers and their usage.

Syllabus

1. Equation of state **(8 lectures)**

1.1 Equations of state
1.2 Andrew's experiment
1.3 Amagat's experiment
1.4 Van der Waals' equation of state
1.5 Critical constants
1.6 Reduced equation of state
1.7 Joule-Thomson porous plug experiment

2. Concepts of Thermodynamics **(8 lectures)**

2.1 Thermodynamic state of a system and Zeroth law of Thermodynamics
2.2 Thermodynamic Equilibrium
2.3 Adiabatic and isothermal changes
2.4 Work done during isothermal changes
2.5 Adiabatic relations for perfect gas
2.6 Work done during adiabatic change
2.7 Indicator Diagram
2.8 First law of Thermodynamics
2.9 Reversible and Irreversible processes

3. Applied Thermodynamics **(8 lectures)**

3.1 Conversion of Heat into Work and its converse
3.2 Carnot's Cycle and Carnot's Heat Engine and its efficiency
3.3 Second law of Thermodynamics
3.4 Concept of Entropy
3.5 Temperature-Entropy Diagram
3.6 T-dS Equation
3.7 Clausius-Clapeyron Latent heat equations

4. Heat Transfer Mechanisms **(8 lectures)**

4.1 Heat Engines
   i. Otto cycle and its efficiency
   ii. Diesel cycle and its efficiency

4.2 Refrigerators:

i. General Principle and Coefficient of performance of refrigerator
ii. The Carnot Refrigerator
iii. Simple structure of vapour compression refrigerator

4.3 Air conditioning: principle and its applications

5. Thermometry (4 lectures)

5.1 Temperature Scales: Centigrade, Fahrenheit and Kelvin scale

5.2 Principle, construction and working of following thermometers

i. Liquid and Gas Thermometers
ii. Resistive Type Thermometer
iii. Thermocouple as thermometer
iv. Pyre heliometer

Reference Books:

1. Physics: 4th Edition, Volume I, Resnick/Halliday/Krane JOHN WILEY & SONS (SEA) PTE LTD
2. Concept of Physics: H.C. Verma, Bharati Bhavan Publishers
3. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand & Company Ltd, New Delhi
4. Heat and Thermodynamics: Mark. W. Zemansky, Richard H. Dittman, Seventh Edition, McGraw-Hill International Editions
5. Thermodynamics and Statistical Physics: J.K. Sharma, K.K. Sarkar, Himalaya Publishing House
6. Thermal Physics (Heat & Thermodynamics): A.B. Gupta, H.P. Roy Books and Allied (P) Ltd, Calcutta.

F. Y. B. Sc.

Term I

Physics Paper II: Section I: Physics Principles and Applications

Lectures: 36 **Credits: 2**

Learning Outcomes:

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

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

Syllabus:

1. Physics of Atoms (12Lectures)

1. The concept of atom (Atomic Models: Thompson and Rutherford)
2. Atomic Spectra
3. Bohr Theory
4. Hydrogen atom Spectra
5. Frank Hertz experiment
6. The LASER
   Absorption, Spontaneous Emission, and Stimulated Emission, Population Inversion and Laser Action, Applications of Lasers

2. Physics of Molecules (10 Lectures)

1. Bonding Mechanisms: A Survey
   i. Ionic Bonds
   ii. Covalent Bonds
   iii. Van der Waals Bonds
   iv. The Hydrogen Bond
   v. Metallic Bond
2. Variation of potential energy with inter-atomic distance
3. Concept of Rotational and vibrational energy levels of diatomic molecule

3. Electromagnetic Waves (14 Lectures)

1. Historical Perspective of Electromagnetic Waves
2. Production of electromagnetic waves : Hertz experiment
3. Electromagnetic spectrum
4. Planck hypothesis of photons (Concept only)
5. Sources of electromagnetic waves : Radio waves, Microwaves, Infrared, Visible light, Ultraviolet, X-rays, Gamma rays
6. Applications
   i. microwave oven
   ii. RADAR
   iii. Pyro electric thermometer
   iv. X-ray radiography and CT Scan
   v. Solar cell

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 (11^{th} Ed. Pearson Education)
4. Nanotechnology : Principles and Practices: S. K. Kulkarni, Capital Publishing Company.

F. Y. B. Sc.
Term II

Physics Paper II: Section II: Electromagnetics

Lectures: 36 **Credits: 2**

Learning Outcomes:

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

1. Demonstrate an understanding of the electric force, field and potential, and related concepts, for stationary charges.
2. Calculate electrostatic field and potential of simple charge distributions using Coulomb's law and Gauss's law.
3. Demonstrate an understanding of the dielectric and effect on dielectric due to electric field.
4. Demonstrate an understanding of the magnetic field for steady currents using Biot-Savart and Ampere's laws.
5. Demonstrate an understanding of magnetization of materials.
6. Demonstrate quantitative problem solving skills in all the topics covered.

Syllabus

1. Electrostatics **(9 Lectures)**

1. Revision of Coulomb's law
2. Superposition principle
3. Electric field due to an electric dipole, line and disc
4. Revision of Gauss's law
5. Coulomb's law from Gauss's law
6. Gauss's law applications in Cylindrical, planar and spherical symmetry

2. Dielectrics **(9 Lectures)**

1. Electric Dipole
2. Electric dipole and dipole moment
3. Electric potential and intensity at any point due to dipole
4. Torque on a dipole placed in an electric field
5. Polar and non-polar molecules
6. Electric polarization of dielectric material
7. Gauss' law in dielectric
8. Electric vectors and relation between them

3. Magneto statics **(9 Lectures)**

1. Revision of Biot-Savart's law with examples
2. Amperes' law, e.g. Solenoid and Toroid
3. Gauss law for magnetism

4. Magnetic properties of materials **(9 Lectures)**

1. Magnetic materials and Bohr magneton
2. Magnetization (M), magnetic intensity (H), magnetic induction (B), magnetic susceptibility and permeability
3. Relation between B, M and H
4. Hysteresis

References:

1. Fundamentals of Physics: 8th Edition, Halliday Resnik and Walkar
2. Electromagnetics: B. B. Laud

F. Y. B. Sc.
Term I and II

Physics paper III: Practical

Total Practicals: 20 **Credits: 4**

Learning Outcomes:

After successfully completing this laboratory course, the students will be able to do the following:

1. Acquire technical and manipulative skills in using laboratory equipment, tools, and materials.
2. Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
3. Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
4. Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
5. Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

Syllabus:

1. Mechanics

1. Range and Least Count of Instruments, Measurements using various instruments and error analysis (Vernier caliper, screw gauge, travelling microscope, spectrometer etc.)
2. Determination MI of disc using ring
3. MI of Flywheel
4. Determination of coefficient of viscosity by Poiseulli's method
5. Determination of Y and n by flat spiral spring
6. Determination of Y by bending
7. Surface Tension by Jeager's method.

2. Heat and Thermodynamics

1. Interpretation of isothermal and adiabatic curves on PV diagrams (Theoretical). Theoretical study of Carnot's cycle by drawing graphs of isothermal and adiabatic curves.
2. Temperature coefficient of resistance
3. Study of thermocouple and determination of inversion temperature
4. Thermal conductivity by Lee's method
5. Specific heat of graphite

3. Light

1. Study of spectrometer and determination of angle of prism
2. Spectrometer calibration. Determination of refractive indices of different colours and plotting the graph of refractive index vs wavelength.
3. Study of total internal reflection using LASER
4. Study of polarization of light by reflection
5. Determination of wavelength of LASER light by plane diffraction grating or cylindrical obstacle.

4. Electricity and magnetism

1. Charging and discharging of a capacitor

2. Study of LR circuit
3. Study of LCR series circuit
4. Study of Kirchhoff's laws
5. Diode characteristics
6. Study of millimetres (all AC, DC ranges, Least Count)
7. Determination of frequency of AC mains

Students have to perform minimum three experiments from each section and total sixteen experiments. Students can perform any two experiments from Computer Aided experiments in place of any two experiments in above four sections.

Additional Activities

1. Demonstrations (Any four demonstrations equivalent to two experiments)
    1. Magnet –magnet interaction
    2. Collision by using balls
    3. Study of Signal generator using CRO (Sine, square wave signal, measurement of AC voltage, frequency)
    4. Demonstration of action potential
    5. Measurement of sound pressure level
2. Computer aided demonstrations (Using computer simulations or animations)
    (Any two demonstrations equivalent to two experiments)
    1. Coulomb's law
    2. Vectors : visualization of vectors
    3. Bohr's model
    4. Carnot engine, diesel engine
    5. Graphs and their slopes, and Kinematics graphs (using computer simulations)
3. Mini projects/Hand on activities
    (Any one equivalent to two experiments)
    1. Students should collect the information of at least five Physicists with their work.
    2. Students should carry out mini projects
4. Study tour (Equivalent to two experiments)
    Students participated in study tour must submit a study tour report.

Students have to perform at least two additional activities out of four activities in addition to sixteen experiments mentioned above. Total Laboratory work with additional activities should be equivalent to twenty experiments.