

UNIVERSITY OF MUMBAI


No. UG/ 84 of 2016-17

CIRCULAR:-

A reference is invited to the Syllabi relating to the B.Sc. degree course, **vide** this office Circular No. UG/130 of 2011, dated 13th June, 2011 and the Principals of affiliated Colleges in Science are hereby informed that the proposal of the concern co-ordinator approved by the Academic Council meeting held on 24th June, 2016 **vide** item No. 4.15 and that in accordance therewith, the revised syllabus as per the Choice Based Credit System for F.Y. B.Sc. Microbiology (Sem. I & II), which are available on the University's web site (www.mu.ac.in) and that the same has been brought into force with effect from the academic year 2016-17.

MUMBAI – 400 032

25th October, 2016


(Dr.M.A.Khan)
REGISTRAR

To,

The Principals of the affiliated Colleges in Science.

A.C/4.15/24.06.2016


No. UG/84-A of 2016

MUMBAI-400 032

25 October, 2016

Copy forwarded with Compliments for information to:-

- 1) The Deans, faculties of Science,
- 2) The Chairman, Board of Studies in Life Science,
- 3) The Professor-cum-Director, Institute of Distance & Open Learning (IDOL)
- 4) The Director, Board of College and University Development,
- 5) The Co-Ordinator, University Computerization Centre,
- 6) The Controller of Examinations.


(Dr.M.A.Khan)
REGISTRAR

PTO..

AC 24/06/2016

Item no. 4.15

UNIVERSITY OF MUMBAI



**Revised Syllabus for F.Y.B.Sc.
Program: B.Sc.
Course:MICROBIOLOGY(USMB)**

(Choice Based Credit System with effect from the
Academic year 2016-17)

PREAMBLE

With the introduction of Choice Based Credit System (CBCS) by the esteemed University from the academic year 2016-2017, the existing syllabus of F.Y.B.Sc. Microbiology is restructured according to the CBCS pattern for its implementation from 2016-2017.

While earlier revision of the syllabus took care of balancing both the basic techniques and some of the advance techniques (as remaining will be introduced phase wise at S.Y.B.Sc. and T.Y.B.Sc level) in Microbiology, the present revision is related to restructuring of syllabus as per CBCS pattern.

The concepts of **Biosafety, Validation, Calibration and SOPs** have been introduced to make the learners aware about :-

- i. The biological hazards and safety measures
- ii. Importance of Validation and Calibration of Scientific equipments in industries and laboratories.
- iii. Writing of SOPs for instruments and their importance at work.

The unique chemistry of living systems results in large part from the remarkable and diverse properties of **Biomacromolecules**. Macromolecules from each of the four major classes may act individually in a specific cellular process, where as others associate with one another to form supramolecular structures. All of these structures are involved in important cellular processes. Since the arrival of information technology, biochemistry has evolved from an interdisciplinary role to becoming a core program for a new generation of interdisciplinary courses such as **bioinformatics and computational biochemistry**. Hence the module of macromolecules has been included in the revised syllabus to teach students the structure and function of biomolecules at an entry level with an objective to raise the student's awareness of the applicability of microcomputers in biochemistry as they go to the higher classes.

F.Y.B.Sc Microbiology Syllabus (General Outline)
Revised for Choice Based Credit System
To be implemented from the Academic year 2016-17

SEMESTER I		
Course Code	Title	Credits
USMB-101 Theory	FUNDAMENTALS OF MICROBIOLOGY.	2 Credits (45 lectures)
Unit-I	History, Introduction & Scope Of Microbiology Prokaryotic Cell Structure,	15 lectures.
Unit-II	Eukaryotic Cell Structure Biosafety In Microbiology	15 lectures.
Unit-III	Macromolecules	15 lectures.
USMB-102 Theory	BASIC TECHNIQUES IN MICROBIOLOGY.	2 Credits (45 lectures)
Unit-I	Microscopy & Staining	15 lectures.
Unit-II	Control Of Microorganisms	15 lectures.
Unit-III	Microbial Nutrition, Cultivation, Isolation & Preservation	15 lectures.
USMBP-1	PRACTICALS	2 Credits
	SECTION-1 FUNDAMENTALS OF MICROBIOLOGY. (Practicals Based On Unit-I, II & III Of USMB-101)	1 Credit (45 lectures)
	SECTION-2 BASIC TECHNIQUES IN MICROBIOLOGY. (Practicals Based On Unit-I, II & III Of USMB-102)	1 Credit (45 Lectures)
SEMESTER II		
USMB-201 Theory	BASICS OF MICROBIOLOGY.	2 Credits (45 Lectures)
Unit-I	Study Of Different Groups Of Microbes-I	15 lectures.
Unit-II	Study Of Different Groups Of Microbes-II	15 lectures.
Unit-III	Microbial Growth	15 lectures.
USMB-202 Theory	EXPLORING MICROBIOLOGY.	2 Credits (45 Lectures)
Unit-I	Microbial Interactions	15 lectures.
Unit-II	Microbes & Human Health	15 lectures.
Unit-III	Advance Techniques In Microbiology & Instrumentation	15 lectures.
USMBP-2	PRACTICALS	2 Credits
	SECTION-1 BASICS OF MICROBIOLOGY. (Practicals Based On Unit-I, II & III Of USMB-201)	1 Credit (45 Lectures)
	SECTION-2 EXPLORING MICROBIOLOGY. (Practicals Based On Unit-I, II & III Of USMB-202)	1 Credit (45 Lectures)

F.Y.B.Sc Microbiology: Detail Syllabus
Revised for Credit Based Semester & Grading System
To be implemented from the academic year 2014-15

Bachelor of Science in Microbiology Duration: Six Semesters			
SEMESTER I			
Course Code	Title	Credits	Notional Periods
USMB-101 Theory	FUNDAMENTALS OF MICROBIOLOGY.	2 Credits (45 lectures)	Self Study (45)
Unit-I	<p>1.1 History, Introduction & Scope Of Microbiology:</p> <ul style="list-style-type: none"> a. Discovery of microorganisms b. Conflict over spontaneous generation c. Golden Age Of Microbiology-Koch Postulate, Medical Microbiology, Immunology d. Development of industrial microbiology and microbial ecology e. Scope and relevance of microbiology f. Future of microbiology <p>1.2 Prokaryotic Cell Structure and functions:</p> <ul style="list-style-type: none"> a. Cell wall b. Cell membrane c. Components external to cell wall-Capsule, Slime layer, Flagella, Pili, Fimbriae d. Cytoplasmic matrix-Inclusion bodies, magnetosomes, ribosomes, gas vesicles e. Nucleoid, Plasmids f. Bacterial endospores and their formation 	15 lectures. (03 + 12 Lec.)	15
Unit-II	<p>2.1 Eukaryotic Cell Structure:</p> <ul style="list-style-type: none"> a. Overview of Eucaryotic cell structure b. The plasma membrane and membrane Structure c. Cytoplasmic matrix, microfilaments, intermediate filaments, and microtubules d. Organelles of the Biosynthetic-secretory and endocytic pathways –Endoplasmic reticulum & Golgi apparatus. Definitions of Lysosome, Endocytosis, Phagocytosis, Autophagy, Proteasome e. Eucaryotic ribosomes f. Mitochondria g. Chloroplasts h. Nucleus –Nuclear Structure i. External Cell Coverings: Cilia And Flagella j. Comparison Of Prokaryotic And Eukaryotic Cells <p>2.2 Biosafety In Microbiology:</p> <ul style="list-style-type: none"> a. Means of laboratory infection 	15 lectures. (12 + 03 Lec.)	15

	<ul style="list-style-type: none"> b. Potentially hazardous procedures c. Responsibility d. Risk Assessment e. Restricted access f. Safety equipments g. Immunization and medical records h. Training of personnel i. Laboratory procedures j. Levels of Containment 		
Unit-III	<p>Macromolecules</p> <p>3.1 Chemical foundations:</p> <ul style="list-style-type: none"> a. Biomolecules as compounds of carbon with a variety of functional groups. b. Universal set of small molecules. c. Macromolecules as the major constituents of cells. d. Configuration and Conformation with definitions and suitable examples only. e. Types of Stereoisomers and importance of stereoisomerism in biology. f. Types of bonds and their importance: Electrovalence, covalent, ester, phosphodiester, thioester, peptide, glycosidic <p>3.2 Water- Structure, properties in brief.</p> <p>3.3 Carbohydrates: Definition, Classification, Biological role. Monosaccharides, oligosaccharides (maltose, cellobiose, sucrose, lactose) and polysaccharide (starch, glycogen, peptidoglycan, cellulose)</p> <p>3.4 Lipids: Fatty acids as basic component of lipids and their classification (Lehninger), nomenclature, storage lipids and structural lipids. Types of lipids with general structure of each and mention examples.</p> <p>3.5 Amino acids & proteins: General structure and features of amino acids (emphasis on amphoteric nature) Classification by R-group, Uncommon amino acids and their functions Peptides and proteins- Definition and general features and examples with biological role. Primary, secondary, tertiary, quaternary structures of proteins- Brief outline.</p> <p>3.6 Nucleic acids: Nitrogenous bases- Purines, Pyrimidines Pentoses-Ribose, Deoxyribose, Nomenclature of Nucleosides and nucleotides, N-β-glycosidic bond, polynucleotide chain to show bonding between nucleotides (Phosphodiester bonds). Basic structure of RNA and DNA.</p>	<p>15 lectures.</p> <p>02 Lec.</p> <p>01 Lec.</p> <p>04 Lec.</p> <p>03 Lec.</p> <p>03 Lec.</p> <p>02 Lec.</p>	15

USMB-102 Theory	BASIC TECHNIQUES IN MICROBIOLOGY.	2 Credits (45 lectures)	Notional Periods Self Study (45)
Unit-I	Microscopy & Staining	15 lectures.	15
	<p>1.1 Microscopy: History of microscopy, Optical spectrum, Lenses and mirrors: Simple and compound light microscope, Dark field Microscopy, Phase contrast</p> <p>1.2 Staining procedures</p> <ol style="list-style-type: none"> a. Dyes and stains: Types, Physicochemical basis Fixatives, Mordants, Decolorizers b. Simple and differential staining c. Special staining (Cell wall, Capsule, Lipid granules ,Spores, Metachromatic granules & Flagella) 	08 Lectures 07 Lectures	
Unit-II	Control Of Microorganisms	15 lectures.	15
	<p>2.1 Definition of frequently used terms & Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectant</p> <p>2.2 Evaluation of disinfectant – Tube dilution & Agar plate techniques, Phenol coefficient , Tissue toxicity index</p> <p>2.3 Physical methods of microbial control</p> <ol style="list-style-type: none"> a. Dry & moist heat – mechanisms, instruments used and their operations b. Electromagnetic radiations – Ionizing radiations, mechanisms –advantages & disadvantages c. Bacteria proof filters d. Low temperature e. Osmotic pressure f. Desiccation <p>2.4 Chemical methods of microbial control - mechanism & advantages & disadvantages (if any) applications.</p> <ol style="list-style-type: none"> a. Phenolics b. Alcohols c. Heavy metals and their compounds d. Halogens e. Quaternary ammonium compounds f. Halogens g. Dyes h. Surfaces active agents/Detergents i. Aldehydes j. Peroxygens k. Sterilizing gases l. 		

	2.5 Chemotherapeutic agents - List types of agents active against various groups & mention the site of action(Detailed mode of action not to be done)		
Unit-III	Microbial Nutrition,Cultivation,Isolation& Preservation	15 lectures.	15
	3.1 Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors. 3.2 Nutritional types of microorganisms 3.3 Types of Culture media with examples 3.4 Isolation of microorganisms and pure culture techniques 3.5 Preservation of microorganisms 3.6 Culture Collection Centres		
USMBP-1	PRACTICALS	2 Credits	Notional Periods
	SECTION-1 FUNDAMENTALS OF MICROBIOLOGY.	1 Credit (45 lectures)	Self Study (45)
Unit-I	1. Assignment : Contribution of Scientists in the field of Microbiology 2. Special staining: Cell wall, capsule, endospore, flagella, lipid, metachromatic granules.		
Unit-II	3. Handling corrosive chemical using rubber teat method for pipetting. Prevention of mouth pipetting and use of auto-pipettes. 4. Discard of highly infectious pathogenic samples like T.B, sputum etc. 5. Explain safety inoculation hood for infection inoculations and laminar air flow. 6. On accidental spillage of/ breakage of culture containers-precautions to be taken. 7. Demonstration of microbes in air, cough, on table surface, finger tips. 8. Permanent slides of Eukaryotes & its organelles: 9. Assignment: Eukaryotic organelles		
Unit-III	10. Qualitative detection : 11. Carbohydrates- Benedicts, Molisch’s test. 12. Proteins, amino acids- Biuret, Ninhydrin. 13. Nucleic acid detection by DPA and Orcinol.		
	SECTION-2 BASIC TECHNIQUES INMICROBIOLOGY.	1 Credit (45 lectures)	Self Study (45)
Unit-I	1. Parts of a microscope, 2. Micrometry 3. Dark field and Phase contrast : Demonstration 4. Monochrome and differential staining procedures, Gram staining& Negative Staining.		
Unit-II	5. Introduction to Laboratory equipments, disinfection & discarding techniques in laboratory 6. Methods of preparation of glassware for Sterilization		

	(Pipettes, Petri Plates, Plastic wares, Flasks, Micropipettes, microtitre plates) & Control of micro organisms using moist heat & dry heat sterilization (Sterilization of Dry powders, Rubber gloves, Bandages, Screw capped tubes, Sterilizable plasticwares) 7. Effect of UV Light, Desiccation, surface tension, Osmotic Pressure, heavy metals(Oligodynamic action) 8. Effect of dyes, phenolic compounds and chemotherapeutic agents(disc inhibition method) 9. Evaluation of Disinfectant by Coupon Method		
Unit-III	10. Preparation of Culture Media: a. Liquid medium(Nutrient Broth) b. Solid Media(Nutrient agar,Sabourauds agar) c. Preparation of slant ,butts & plates 11. Inoculation techniques and Study of Growth: a. Inoculation of Liquid Medium b. Inoculation of Solid Media(Slants, Butts and Plates) c. Study of Colony Characteristics of pigment & non-pigment producing bacteria. d. Study of Motility (Hanging Drop Preparation) 12. Use of Differential & Selective Media: (MacConkey & Salt Mannitol Agar) 13. Determination of Optimum growth conditions: a)Temperature, b) pH 14Methods of Preservation of culture		
SEMESTER II			Notional Periods
USMB-201 Theory	BASICS OF MICROBIOLOGY.	2 Credits (45 lectures)	Self Study (45)
Unit-I	Study Of Different Groups Of Microbes-I: 1.1 Viruses: a) Historical highlights, General properties of viruses, prions, viroids b) Structure of viruses-capsids, envelopes, genomes, c) Cultivation of viruses- overview d) Bacteriophages: Lytic cycle. Lysogeny, Structure and Life cycle of T4 phage. 1.2 Rickettsia, Coxiella, Chlamydia, Mycoplasma: general features, medical significance 1.3 Actinomycetes: General features of Nocardia and Streptomyces Importance: ecological, commercial and medical 1.4 Archaea: Introduction- Major Archaeal physiological groups, Archaeal cell wall, lipids and membranes, Ecological importance	15 lectures. 07 Lectures 03 Lectures 02 Lectures 03 Lectures	15

Unit-II	Study Of Different Groups Of Microbes-II: Classification, Morphological characteristics, cultivation, reproduction and significance 2.1 Protozoa- Major Categories of Protozoa Based on motility, reproduction. Medically important Protozoa Life cycle of Entamoeba 2.2 Algae - Characteristics of algae: morphology, Pigments, reproduction Cultivation of algae. Major groups of Algae –an overview. Biological, Medical and economic importance of Algae. Differences between Algae and Cyanobacteria 2.3 Fungi and Yeast- Characteristics: structure, Reproduction. Cultivation of fungi and yeasts. Major fungal divisions- overview. Life cycle of yeast, Biological and economical importance 2.4 Slime molds and Myxomycetes	15 lectures. 04 Lectures 05 Lectures 05 Lectures 01 Lecture	15
Unit-III	Microbial Growth: 3.1 a. Definition of growth, Mathematical Expression, Growth curve b. Measurement of growth c. Direct microscopic count – Breed’s count ,Petroff – Hauser counting chamber- Haemocytometer. d. Viable count – Spread plate and Pour plate technique e. Measurements of cell constituents. f. Turbidity measurements – Nephelometer and spectrophotometer techniques g. Synchronous growth, Continuous growth (Chemostat and Turbidostat) h. Influence of environmental factors on growth. i. Microbial growth in natural environment. j. Counting viable non-culturable organisms-Quorum sensing techniques	15 lectures.	15
USMB-202 Theory	EXPLORING MICROBIOLOGY.	2 Credits (45 lectures)	Self Study (45)
Unit-I	Microbial Interactions:	15 lectures.	15
	1.1 Types of Microbial Interactions : Mutulism, Cooperation, Commensalisms, Predation Parasitism, Amensalism, Competition 1.2 Human Microbe Interactions . a) Normal flora of the human body : Skin, Nose & Nasopharynx, Oropharynx, Respiratory tract, Eye, External ear, Mouth, Stomach, Small intestine, Large intestine, Genitourinary tract . b) Relationship between microbiota& the host . c) Gnotobiotic animals 1.3 Microbial associations with vascular plants a) Phyllosphere		

	b) Rhizosphere & Rhizoplane c) Mycorrhizae d) Nitrogen fixation : Rhizobia, Actinorhizae, Stem Nodulating Rhizobia e) Fungal & Bacterial endophytes f) Agrobacterium & other plant pathogens		
Unit-II	Microbes & Human Health:	15 lectures.	15
	<p>2.1 Difference between infection & disease. Important terminology: Primary infection, secondary infection, Contagious infection, occupational disorder, clinical infection, subclinical infection, Zoonoses, genetic disorder, vector borne infection.</p> <p>2.2 Factors affecting infection: Microbial factors: adherence, invasion, role of virulence factors in invasion, colonization & its effects. Host factors: natural resistance, species resistance, racial resistance.</p> <p>2.3 Individual resistance: Factors influencing individual resistance: Age, nutrition, personal hygiene, stress, hormones, Addiction to drugs/ alcohol. Interaction between Microbes & host is dynamic.</p> <p>2.4 Host defense against infection: Overview i) First line of Defence: for skin, respiratory tract, gastrointestinal tract, genitourinary tract, eyes. ii) Second line of defence: Biological barriers: Phagocytosis, Inflammation iii) Third line of defence: Brief introduction to antibody mediated & cell mediated immunity.</p>		
Unit-III	Advance Techniques In Microbiology & Instrumentation:	15 lectures.	15
	<p>3.1 Electron Microscope: TEM, SEM, 3.2 Contrast enhancement for electron microscope 3.3 Fluorescent Microscope, Confocal Microscope 3.4 pH meter ,pH meter Validation and calibration 3.5 Colorimeter 3.6 Validation and calibration of Autoclave & Hot air Oven 3.7 Concepts :Laminar air flow systems, Biosafety cabinets , Walk in Incubators, Industrial autoclaves, Cold Room.</p>		
USMBP-2	PRACTICALS	2 Credits	
	SECTION-1 BASICS OF MICROBIOLOGY.	1 Credit (45 lectures)	Self Study (45)
Unit-I	1. Spot assay and plaque assay of Bacteriophage (Demonstration) 2. Slide Culture technique (Actinomycetes & Fungal Culture)		
Unit-II	3. Isolation of yeast, cultivation of other fungi Cultivation on Sabourauds agar		

	4. Static & Shaker Cultures 5. Fungal Wet mounts & Study of Morphological Characteristics :Mucor,Rhizopus,Aspergillus, Penicillium, 6. Permanent slides of Algae, Protozoa		
Unit-III	7. Growth curve (Demonstration) only in complex media. 8.Breed's Count 9.Haemocytometer 10.Viable count: Spread plate and pour plate 11.Brown's opacity 12.Effect of pH and temperature on growth 13.Measurement of cell dimensions-Micrometry		
	SECTION-2 EXPLORING MICROBIOLOGY.	1 Credit (45 lectures)	Self Study (45)
Unit-I	1. Normal flora of the Skin & Saliva 2. Wet Mount of Lichen 3. Bacteroid Staining & Isolation of Rhizobium 4. Azotobacter isolation & staining		
Unit-II	6.Study of virulence factors – Enzyme Coagulase 7.Study of virulence factors – Enzyme Hemolysin 8.Study of virulence factors – Enzyme Lecithinase		
Unit-III	9.Use of standard buffers for calibration and determination of pH of a given solution 10.Determination of λ_{max} & Verification of Beer Lambert's law 11.Determination & efficiency of Autoclave, Hot air oven , LAF 12.Writing of SOP's for Instruments 13.Visit to a Microbiology laboratory in a research Institute		

REFERENCES: USMB 101 & USMB 201

1. Prescott ,Hurley.Klein-Microbiology, 7th edition, International edition, McGraw Hill.
2. Kathleen Park Talaro& Arthur Talaro - Foundations in Microbiology International edition 2002,| McGraw Hill.
3. Michael T.Madigan & J.M.Martin,Brock ,Biology of Microorganisms 12th Ed. International edition 2006, Pearson Prentice Hall.
4. A.J.Salle,Fundamental Principles of Bacteriology.
5. Stanier.Ingraham et al ,General Microbiology 4th & 5th Ed. 1987, Macmillan Education Ltd
6. Microbiology TMH 5th Edition by Michael J.Pelczar Jr., E.C.S. Chan ,Noel R. Krieg
7. BIS:12035.1986: Code of Safety in Microbiological Laboratories

8. Outlines of Biochemistry 5/E, Conn P. Stumpf, G. Bruening and R. Doi. John Wiley & Sons. New York 1995
9. Lehninger. Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman and Company. New York 2005
10. Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. Adisson Wesley Longman Inc. 1998.

REFERENCES: USMB 102& USMB 202

1. Microbiology TMH 5th Edition by Michael J.Pelczar Jr., E.C.S. Chan ,Noel R. Krieg
2. A.J.Salle, Fundamental Principles of Bacteriology,McGraw Hill Book Company Inc.1984
3. Cruikshank, Medical Microbiology , Vol -II
4. Prescott ,Hurley.Klein-Microbiology, 5th & 6th edition, International edition 2002 & 2006, McGraw Hill.
5. Michael T.Madigan & J.M.Martin,Brock ,Biology of Microorganisms 11th Ed. International edition ,2006, Pearson Prentice Hall.

MODALITY OF ASSESSMENT

Theory Examination Pattern:

(A) Semester End Theory Assessment -

100 Marks

- i. Duration - These examinations shall be of **3 Hours** duration.
- ii. Theory question paper pattern :-
 1. There shall be **four** questions. On each unit there will be one question with **25** Marks each & fourth one will be based on all the three units with **25** Marks.
 2. All questions shall be **compulsory** with internal choice within the questions. Question 1 (Unit-I),Question 2 (Unit-II) & Question 3 (Unit-III) & Question 4 (combined units) will be of **50** Marks with internal options.
 3. All Questions may be sub divided into sub questions of **five** marks objective questions and **twenty** marks of short or long questions of 5 to 10 marks each. Please ensure that the allocation of marks depends on the weightage of the topic

PRACTICAL EXAMINATION PATTERN

(B) External (Semester end practical examination) :- 50 Marks Per Section

(Section-I based on course-1 & Section-II based on course-2)

Sr.No.	Particulars	Marks	Total
1.	Laboratory work (Section-I + Section-II)	40 + 40	= 80
2.	Journal	05 +05	= 10
3.	Viva	05 + 05	= 10

PRACTICAL BOOK/JOURNAL

Semester I:

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department ; failing which the student will not be allowed to appear for the practical examination.

Semester II

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department ; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

Semester I

Course	USMB-101	USMB-102	Grand Total
Theory	100	100	200
Practicals	50	50	100

Semester II

Course	USMB-201	USMB-202	Grand Total
Theory	100	100	200
Practicals	50	50	100

AC 7-4-2014
Item No. – 4.7

UNIVERSITY OF MUMBAI



Syllabus for the Interdisciplinary B. Sc.

Module: Chemistry

(Credit Based Semester and Grading System with
effect from the academic year 2014–2015)

Preamble

As per the perspective plan of the University which was approved by the Management Council on 11th September 2013 & subsequently by the Academic Council on 19th September 2013, University of Mumbai is going to offer B.Sc. Interdisciplinary programme under the category of Innovative programmes from the academic year 2014-2015. The main objective of this course is to make the learner well versed with all science disciplines as science graduate so that he/she can have scope in schools, banks or any offices as well as they can pursue post graduation in the major subject.

The Rational:

The basic thoughts and understanding in the programme of BSc with interdisciplinary science is, many or around 60 % students after their graduation leave higher education and opt for jobs. These jobs are in Government offices, Municipal Corporations, private companies or, in schools as teachers. They are absorbed as science graduates. Even when the students opt for management carriers they are considered as science graduates at entry level. Thus the specialization or the major subject does not have relevance unless the students want to pursue the carrier in the field of research or higher education. Similarly those who enter in jobs of teachers find it difficult to teach other science subjects as required, than the subject of specialization, because they are not exposed to those branches of science.

With all these requirements of job market University has decided to introduce the graduation course in science as BSc interdisciplinary science. In this a learner can take two subjects from science discipline at first year level, from among these one subject can be selected at Second Year and the same will be continued as major subject along with applied component for final year B. Sc. The learner will earn 70 credits as explained in this subject like the existing system. In first year instead of the third subject the learner can opt any subject from the prescribed modules and as per the availability in the college / institute where admitted. These modules can be called as interdisciplinary modules. At the second year level instead of the second minor subject the learner can opt the modules from the interdisciplinary modules. The foundation course is also modified for interdisciplinary science which includes topics like Law, Economics, Sociology, Political Science etc.

Thus the learner will earn 70 credits in the major subject as obtained by any student in current traditional method. The remaining 50 credits can be earned from the interdisciplinary courses. The modules of interdisciplinary courses can be from science branches or arts / commerce / law / fine arts branches.

Keeping these things in mind the topics included in chemistry modules are experiments with the skill developments which will fulfill the need of the learners. The syllabus includes basic topics in chemistry which will help the learner to know the basic Chemistry & if learner wishes to pursue higher studies same knowledge will be useful.

Interdisciplinary B.Sc Syllabus - Modules in Chemistry
To be implemented from the Academic year 2014-2015

Module I
Theory

Course	Title	Credits	L / Week
USIDCH01		2	3

Practicals

USIDCHP01	Practicals of Course USIDCH01	1	3
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Module II
Theory

Course	Title	Credits	L / Week
USIDCH02		2	3

Practicals

USIDCHP02	Practicals of Course USIDCH02	1	3
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Detailed Syllabus for Interdisciplinary Courses in Chemistry
To be implemented from the Academic year 2014-2015

Module I (Detailed Syllabus)
Theory

Course	Unit	Topics	Credits	L/Week
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<p>USIDCH 01</p>	<p>I</p>	<p>1.1 CHEMICAL THERMODYNAMICS (4L) Thermodynamic terms: System, Surrounding, Boundaries Sign Conventions, State Functions, Zeroth law- Statement, Internal Energy and Enthalpy: Significance, examples, (Numericals expected.) First law of Thermodynamics and its limitations, Second law – Statements and discussion, Mathematical expression.</p> <p>1.2 CHEMICAL KINETICS (2L) Rate of Reaction, rate constant, Measurement of Reaction Rates Order & Molecularity of reaction, Integrated rate equation of first and second order (with equal initial concentration of reactants) reactions. (Derivation not expected). (Numericals expected)</p> <p>1.3 MOLECULAR SPECTROSCOPY-I (2L) Electromagnetic radiation, Electromagnetic Spectrum, Planck’s equation, Interaction of EMR with matter- 2.2</p> <p>1.4 POLYMERS-I (3L) Monomer, Repeat Unit, Polymer, Linear and Branched polymers, Homopolymer, Copolymer, Types of copolymers-Random, Block, Alternate, Graft. Natural Polymers-Source, Structure & Properties of Starch, Cellulose, Protein, Silk, Wool, Rubber.</p> <p>1.5 Scope and Introduction to analytical chemistry (4L) 1.5.1 Analytical chemistry Qualitative and Quantitative analysis ,Chemical analysis –Based on nature of information of the sample sought and based on size of the sample used ,Classification of analytical method-Classical and Instrumental methods – types, advantages and disadvantages</p>	<p>1</p>	<p>1</p>
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	<p>1.5.2 Applications of analytical methods in various fields</p> <p>Organic, Pharmaceuticals, Electronic and Environmental analysis</p>		
II	<p>2.1 Calibration of Glass ware and Chemical calculations (7L)</p> <p>2.1.1 Calibration of pipette, volumetric flask, Burette</p> <p>2.1.2 Measurements in analytical chemistry S.I units -Fundamental Units (Mass, amount of substance, distance, time, temperature, current) Uncertainty of measurements Significant figures- concept, Rules and examples (Numericals expected)</p> <p>2.1.3 Chemical calculations Expressing concentration of solutions –Normality, Molality, Molarity, Formality, Mole fraction, ppb, ppm, millimoles, milliequivalents. (Numericals expected)</p> <p>2.2 Concept of Qualitative Analysis: (8L) (Macro, Semi-Micro, Micro, Ultra Micro, Trace Analysis)</p> <p>2.2.1 Testing of Gaseous Evolutes, Role of Papers impregnated with Reagents in qualitative analysis (With reference to papers impregnated with Starch-Iodide, Potassium Dichromate, Lead acetate, Dimethyl Glyoxime, and Oxine reagents) (balanced Chemical Reactions expected).</p> <p>2.2.2 Precipitation Equilibria: Effect of Common Ions, Uncommon Ions; Oxidation State, Buffer Action, Complexing agents on precipitation of ionic compounds.</p>	1	1

	(Balanced Chemical Equations and Numerical Problems Expected).		
III	<p>3.1 Chemical Bonding(3L)</p> <p>Types of chemical bonds; Comparison between ionic and covalent bonds; polarizability (Fajan's Rules)</p> <p>Shapes of simple molecules: Lewis Dot structures; Sidgwick-Powell theory; Basic VSEPR Theory for AB_n type molecules with and without lone pair of electrons, Isoelectronic Principle.</p> <p>3.2 Bonding and structure of organic compounds (5L)</p> <p>3.2.1 Types of arrows and their significance. (8 types)</p> <p>3.2.2 Electronic effects in organic molecules: Inductive effect (or polarisation), polar covalent bonds and dipole moment. Delocalised bonds and resonance - drawing resonance structures, concept of formal charge, hyperconjugation.</p> <p>3.2.3 Bonds weaker than a covalent bond: Hydrogen bond – intermolecular hydrogen bonding in alcohols - effect on b.p. and solubility; Van der Waal's forces in straight and branched chain alkanes.</p> <p>3.3 Nomenclature of organic compounds (4L)</p> <p>Review of basic rules of IUPAC nomenclature. Nomenclature of mono & bi-functional aliphatic compounds on the basis of priority order of the following classes of compounds: alkanes, alkenes, alkynes, haloalkanes, alcohols, ethers, aldehydes, ketones, carboxylic acids, carboxylic acid derivatives (acid halides, esters, anhydrides, amides), nitro compounds, nitriles & amines; including their cyclic analogues.</p>	1	1

	<p>3.4 Fundamentals of organic reaction mechanisms. (1L) Carbocations(alkyl) , Carbanions : (trichloromethyl)</p> <p>3.5 Reagents: (1L) Electrophiles and nucleophiles.</p> <p>3.6 RECENT TRENDS (1L) Introduction to Premier Indian research Institutes in Chemistry, Shantiswaroop Bhatnagar Awardees in last 5 years in Chemistry. Nobel prize winners in Chemistry in last 5 years.</p>		
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PRACTICAL COURSE IN USIDCH P1

1. To determine the rate constant for the hydrolysis of ester using HCl as catalyst.
2. To determine the rate constant for the hydrolysis of ester using H₂SO₄ as catalyst, using scientific calculator by Regression analysis.
3. Determination of amount of NaHCO₃ + Na₂CO₃ in the given solid mixture titrimetrically.
4. Determination of % composition of BaSO₄ and NH₄Cl in the given mixture gravimetrically.
5. Semi-Micro Inorganic Qualitative Analysis of a sample containing Two Cations and Two Anions. Cations: (from amongst) Pb²⁺, Ba²⁺, Ca²⁺, Sr²⁺, Cu²⁺, Cd²⁺, Fe³⁺, Ni²⁺, Mn²⁺, Mg²⁺, Al³⁺, Cr³⁺, K⁺, NH₄⁺
Anions : (from amongst) CO₃²⁻, SO₃²⁻, S²⁻, NO₂⁻, NO₃⁻, Cl⁻, Br⁻, I⁻, SO₄²⁻, PO₄³⁻
(Scheme of analysis should avoid use of sulphide ion in any form for precipitation /separation of cations). (Two mixtures)
6. **Crystallization**
Acetanilide / salicylic acid from hot water using fluted filter paper.
7. **Characterization organic compounds containing only C, H, (O) elements:**
Compounds belonging to the following classes: carboxylic acid, phenol, aldehyde/ ketone, ester, alcohol (Minimum any 3 compounds)

Detailed Syllabus for Interdisciplinary Courses in Chemistry
To be implemented from the Academic year 2014-2015

Module II (Detailed Syllabus)
Theory

Course	Unit	Topics	Credits	L/Week
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USIDCH 01	I	1.1 GASEOUS STATE (4L) Ideal Gas laws, Ideal gases, real gases, compressibility factor. Deviation from ideal gas laws, reasons for deviation from ideal gas laws, van der Waals equation of state, Joule-Thomson effect –qualitative discussion and experimentation,. 1.2 NUCLEAR CHEMISTRY-I (4L) Natural Radioactivity – Introduction, Types of radiation (α , β , γ) & their properties. Isobars, Isotopes & Isotones. Decay constant and half life period (Numericals expected). 1.3 BUFFERS (3L) – Introduction, Types of buffers, Buffer action, Buffer capacity. Hendersons equation (Numericals expected.) 1.4 Introduction to Gravimetric Analysis (4L) 1.4.1 Solubility product and Precipitation. 1.4.2 Factors affecting solubility of precipitate. 1.4.3 Conditions of precipitation, nucleation, particle size, crystal growth, colloidal state, ageing of precipitate/ digestion of precipitate.	1	1
	II	2.1 Titrimetric Analysis –I (7L) 2.1.1 Terms – Titration ,Titrant , titrand, End point, Equivalence point, Titration Error ,Indicator 2.1.2 Primary and Secondary standards- characteristics and examples 2.1.3 Types of Titration –Acid –Base, Redox. Precipitation, Complexometric titration. 2.2 Comparative Chemistry of Main Group Elements: Metallic and Non-Metallic Nature, Oxidation States, Electronegativity, Anamolous behavior of Second Period elements, allotropy. Catenation, Diagonal relationship.	1	1

	<p>(4 L)</p> <p>2.2.1 Comparative Chemistry of Some important compounds: a) Na_2CO_3; b) NaOH; c) NaCl; d) NaHCO_3; e) CaO; CaCO_3 (2L)</p> <p>2.2.2 Oxides of Nitrogen with respect to Environmental aspects. (2L)</p>		
III	<p>3.1 Acid-Base Theories (3L) Arrhenius ; Lowry-Bronsted ;Lewis ; Solvent Solute; Lux-Flood; Hard and Soft Acids and Bases-HSAB; Usanovich Definition.</p> <p>3.2 Stereochemistry of organic Compounds (4L)</p> <p>3.2.1 Isomerism – Types of isomerism: constitutional isomerism (chain, position and functional) and stereoisomerism.</p> <p>3.2.2 Chirality: Configuration, asymmetric carbon atom, stereogenic/ chiral centers, chirality,</p> <p>3.2.3. Stereochemistry of carbon compounds with one and two similar and dissimilar asymmetric carbon atoms; enantiomers, diastereomers, and racemic mixtures threo, erythro and meso isomers.</p> <p>3.3 Mechanism of organic reactions:(4L)</p> <p>3.3.1 Classification of organic reactions based on mechanism.</p> <p>3.3.2 Substitution: Nucleophilic substitution in alkyl halides ($\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$), electrophilic substitution in benzene (Friedel Crafts alkylation).</p> <p>3.3.3 Addition: Electrophilic addition (Markovnikov addition of HX to alkenes); Radical addition (AntiMarkovnikov addition of HBr to alkenes in presence of peroxide);</p> <p>3.4 Functional group interconversion based on the</p>	1	1

	<p>following reactions: (3L)</p> <p>3.4.1 Alkanes: Methods of formation: Kolbe reaction, Wurtz reaction, decarboxylation of carboxylic acids; hydrolysis of Grignard reagent.</p> <p>3.4.2 Alkenes: Methods of formation: hydrohalogenation of alkyl halides; Reactions: Addition of hydrogen, halogen, HX; oxidation using KMnO_4.</p> <p>3.4.3 Alkynes: Methods of formation: Dehydrohalogenation of alkyl dihalides, Reactions: Addition of hydrogen, HX.</p> <p>3.5 RECENT TRENDS (1L)</p> <p>Introduction to Premier Indian research Institutes in Chemistry, Shantiswaroop Bhatnagar Awardees in last 5 years in Chemistry. Nobel prize winners in Chemistry in last 5 years.</p>		
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PRACTICAL COURSE: USIDCHP2

1. To standardize commercial sample of NaOH using KHP and to write material safety data of the chemicals involved.
2. To standardize commercial sample of HCl using Borax and to write material safety data of the chemicals involved.
3. Determination of acetic acid in Vinegar by titrimetric method.
4. Determination of the amount of Mg(II) present in the given solution complexometrically

5. Inorganic Preparations: Copper Sulfate from Copper(II) Oxide;
6. Volumetric Analysis:- Determination of the strength of sodium carbonate and sodium bicarbonate by titration with standard acid solution using phenolphthalein and methyl orange as indicators;
7. **Characterization of organic compounds containing C, H, (O), N, S and halogen elements.** (Element tests to be done). (Minimum 3 compounds)
Compounds belonging to the following classes: amine, amide, nitro compound,

SUGGESTED REFERENCE (Module I & II) Unit I

1. **Physical Chemistry** N.B. Singh, Shiv saran das, Ramji Singh.
New Age International (P) Limited, 2nd ed. 2007
2. **Principle of Physical Chemistry**, B.R.Puri, L.R.Sharma, M.S.Pamania
Vishal Publish Co. Jalandhar. 45th ed.
3. **Chemistry For Degree Students Bsc First Year**, Dr. R. L. Madan , S. Chand & Company Ltd, 1st Ed, 2010
4. **Physical Chemistry** , Vol I & II , N.B. Singh Shiv Saran Das . A.K.Singh
New age international (P) Limited First ed. 2009
5. **Essentials Of Physical Chemistry**, Arun Bahl B.S. Bahl, G.D. Tuli , S. Chand & company ,Rensed ed 2009, Reprint 2010.
6. **Chemistry John E. Mc Murray & Robest Fay**, 5th ed Pearsan 2011.
7. **Essentials Of Nuclear Chemistry**, H.J Arnika Fourth Revised ed. 2011
reprint 2012 new age international (P) limited publish
8. **Elements Of Physical Chemistry** by Atkins , 4th. Ed.

SUGGESTED REFERENCE (Module I & II) Unit I & II

1. Fundamental of Analytical Chemistry-Skoog D.A. and West D.M. Saunders, College Publication
2. Introduction to Instrumental Analysis, R. D. Brown, McGraw Hill.
3. Instrumental Methods of Analysis, H. H. Willard, L. L. Meritt and J. A. Dean, Affiliated East-West Press.
4. Quality in the Analytical Chemistry laboratory –Neil T.Crosby,Florence Elizabeth Prichard, Ernest.J Newman – John Wiley&Sons Ltd

5. Principles and Practice of Analytical Chemistry-Fifield F.W. and Kealey D, Black well Science
6. Analytical Chemistry, Christain, WSE / Wiley
7. Basic concepts of Analytical Chemistry, S.M.Khopkar, New Age International(P) Ltd.
8. Quantitative Analysis, R.A Day &A.L Underwood, Prentice Hall Publication

Chemical Analysis in the laboratory –A Basic guide by Irene Muller-Harvey ,Richard .M.Baker ,Royal Society of Chemistry.

SUGGESTED REFERENCE (Module I & II) Unit II & III

1. J. Barrett and A. Malati, ‘Fundamentals of Inorganic Chemistry’,East-West Press Edition(2006)
2. C.M. Day and Joel Selbin, ‘Theoretical Inorganic Chemistry’, Affiliated East West Press Pvt.Ltd., (1985).
3. J.D.Lee, Concise ‘Inorganic Chemistry’, 5th ed., Blackwell Science Ltd., (2005).
4. James E.Huheey, ‘Inorganic Chemistry’, 3rd edition, Harper & Row, Publishers, Asia, Pte Ltd., (1983).
5. R. J. Gillespie and I. Hargittai, The VSEPR Model of Molecular Geometry,Dover Publication,(2012).
6. J. Barrett, ‘Inorganic Chemistry in Aqueous Solutions’; The Royal Society of Chemistry (2003).
7. T. Moeller and R. O’Connor, ‘Ions in Aqueous Systems’; McGraw-Hill Book Company, (1972).
8. B. Douglas, D.H. McDaniel and J.J.Alexander, Concepts and Models of Inorganic Chemistry, 2nd edition, John Wiley & Sons, (1983).
9. Gary Wulfsberg, Inorganic Chemistry ; Viva Books PA Ltd., New Delhi; (2002).
10. W. W. Porterfield, *Inorganic Chemistry-An Unified Approach*, Academic press(1993);
- 11.D. F. Shriver, P.W.Atkins and C.H. Langford, Inorganic Chemistry, 3rd edition Oxford University Press, (1999).
- 12.Asmik Das, *Fundamental Concepts of Inorganic Chemistry*,(Volumes-I,II and III)CBS Pub.(2000).
13. N. N. Greenwood and A.Earnshaw, Chemistry of Elements, Pergamon, (1984).
14. P. K. Datta, ‘General and Inorganic Chemistry’,Levant Books,15th Edition,(2003).

SUGGESTED REFERENCE : (Paper I & II) Unit III

1. Janice Smith, Organic Chemistry, Tata McGraw-Hill Book Company
2. John McMurry, Organic Chemistry, 5th Ed. Cornell University
3. Paula Bruice, Organic Chemistry, 3rd Ed. Pearson Education.

4. A guide to IUPAC Nomenclature of Organic Compounds : RicherInterscience Publications
5. T.W.G.Solomons and C.B.Fryhle , Organic Chemistry, John Wiley and Sons
6. Francis Carey and Robert Giuliano, Organic Chemistry, 8th Ed. Tata McGraw-Hill Book Company
7. R. R. Morrison, R.M.Boyd and S.K. Bhattacharjee , Organic Chemistry, Pearson Education
- 8.P.S.Kalsi, Stereochemistry, Conformation and Mechanism, New Age International Publishers, 7th Ed.
9. G.Marc Loudon, Fundamentals of Organic Chemistry, 2002, 4th Ed.
10. Peter Sykes, Reaction Mechanism, 1999, Orient Longman
11. Seyhan N.Ege, Organic Chemistry, 1984. D.C.Heath & Co.
12. S. P. Bhutani, Organic Reactions With Mechanism, Ane book Pvt.Ltd.

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Semester I USBO101		L	Cr
Paper I -- Plant Diversity 1		45	2
<u>UNIT I</u>		15	
<u>ALGAE</u>			
1	Structure, life cycle and systematic position of <i>Nostoc</i> and <i>Spirogyra</i> .		
2	Economic importance of Algae.		
<u>UNIT II</u>		15	
<u>FUNGI</u>			
1	Structure, life cycle and systematic position of <i>Rhizopus</i> and <i>Aspergillus</i>		
2	Economic importance of Fungi.		
3	Modes of nutrition in Fungi (Saprophytism and Parasitism).		
<u>UNIT III</u>		15	
<u>BRYOPHYTA</u>			
1	General characters of Hepaticae		
2	Structure, life cycle and systematic position of <i>Riccia</i> .		

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Semester I USBO102		L	Cr
Paper II – Form and Function 1		45	2
UNIT I		15	
CELL BIOLOGY			
1	General structure of plant cell: cell wall Plasma membrane (bilayer lipid structure, fluid mosaic model)		
2	Ultra structure and functions of the following cell organelles: Endoplasmic reticulum and Chloroplast		
UNIT II		15	
ECOLOGY			
1	Energy pyramids, energy flow in an ecosystem.		
2	Types of ecosystems: aquatic and terrestrial.		
UNIT III		15	
GENETICS			
1	Phenotype/Genotype, Mendelian Genetics- monohybrid, dihybrid; test cross; back cross ratios.		
2	Epistatic and non epistatic interactions; multiple alleles.		

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Semester I USBOP1		L	Cr
PRACTICAL Paper I – Plant Diversity 1		30	1
1	Study of stages in the life cycle of <i>Nostoc</i> from fresh/ preserved material and permanent slides.		
2	Study of stages in the life cycle of <i>Spirogyra</i> from fresh/ preserved material and permanent slides.		
3	Economic importance of algae: <i>Ulva</i> (Biofuel), <i>Spirulina</i> (Neutraceutical), <i>Gelidium</i> (Agar)		
4	Study of stages in the life cycle of <i>Rhizopus</i> from fresh/ preserved material and permanent slides.		
5	Study of stages in the life cycle of <i>Aspergillus</i> from fresh/ preserved material and permanent slides.		
6	Economic importance of Fungi: Mushroom , Yeast, wood rotting fungi (any bracket fungus).		
7	Study of stages in the life cycle of <i>Riccia</i> from fresh/ preserved material.		
8	Study of stages in the life cycle of <i>Riccia</i> with the help of permanent slides.		
PRACTICAL PAPER II- FORM AND FUNCTION 1		30	1
1	Examining various stages of mitosis in root tip cells (<i>Allium</i>)		
2	Cell inclusions: Starch grains (Potato and Rice); Aleurone Layer (Maize)		
3	Cystolith (<i>Ficus</i>); Raphides (<i>Pistia</i>); Sphaeraphides (<i>Opuntia</i>).		
4	Identification of cell organelles with the help of photomicrograph: Plastids: Chloroplast, Amyloplast, Endoplasmic Reticulum and Nucleus		
4	Identification of plants adapted to different environmental conditions: Hydrophytes: Floating: Free floating (<i>Pistia/Eichornia</i>); Rooted floating (<i>Nymphaea</i>); Submerged (<i>Hydrilla</i>)		
5	Mesophytes (any common plant); Hygrophytes (<i>Typha/Cyperus</i>)		

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6	Xerophytes : Succulent (<i>Opuntia</i>); Woody Xerophyte (<i>Nerium</i>); Halophyte (<i>Avicennia</i> pneumatophore) No sections in ecology, only identification and description of specimens. Morphological adaptations only.		
7	Calculation of mean, median and mode.		
8	Calculation of standard deviation.		
9	Frequency distribution, graphical representation of data- frequency polygon, histogram, pie chart.		
10	Study of Karyotypes: Human: Normal male and female, <i>Allium cepa</i> .		

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Semester II USBO201		Hrs	Cr
Paper I -- Plant Diversity 1		45	2
UNIT I		15	
<u>PTERIDOPHYTES</u>			
1	Structure life cycle, systematic position and alternation of generations in <i>Nephrolepis</i>		
2	Stelar evolution		
UNIT II		15	
<u>GYMNOSPERMS</u>			
2	Structure life cycle systematic position and alternation of generations in <i>Cycas</i>		
3	Economic importance of Gymnosperms		
Unit III			
<u>ANGIOSPERMS</u>		15	
1.	Leaf: simple leaf, types of compound leaves, Incisions of leaf, venation, phyllotaxy, types of stipules, leaf apex, leaf margin, leaf base, leaf shapes. Modifications of leaf: spine, tendril, hooks, phyllode, pitcher, <i>Drosera</i> or insectivorous plants.		
2	Inflorescence: Racemose: simple raceme, spike, catkin, spadix, panicle. Cymose: monochasial, dichasial, polychasial. Compound: corymb, umbel, cyathium, capitulum, verticillaster, hypanthodium.		
3	Study of following families: Malvaceae, Amaryllidaceae.		

Semester II USBO202		Hrs	Cr
Paper II – Form and Function 1		45	2
UNIT I		15	
<u>ANATOMY</u>			
1	Simple tissues, complex tissues.		
2	Primary structure of dicot and monocot root, stem and leaf.		
3	Epidermal tissue system: types of hair, monocot and dicot stomata.		

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UNIT II		15	
PHYSIOLOGY			
1	Photosynthesis: Light reactions, photolysis of water, photophosphorylation (cyclic and non cyclic), carbon fixation phase (C ₃ , C ₄ and CAM pathways).		
UNIT III		15	
MEDICINAL BOTANY			
1	Concept of primary and secondary metabolites, difference between primary and secondary metabolites.		
2	Grandma's pouch: Following plants have to be studied with respect to botanical source, part of the plant used, active constituents present and medicinal uses: <i>Oscimum sanctum</i> , <i>Adathoda vasica</i> , <i>Zinziber officinale</i> , <i>Curcuma longa</i> , <i>Santalum album</i> , <i>Aloe vera</i> .		

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Semester II USBOP2		Cr
PRACTICAL Paper I – Plant Diversity 1		1
1	Study of stages in the life cycle of <i>Nephrolepis</i> : Mounting of ramentum, hydathode, T.S. of rachis.	
2	T.S. of pinna of <i>Nephrolepis</i> passing through sorus.	
3	Stelar evolution with the help of permanent slides: Protostele: haplostele, actinostele, plectostele, mixed protostele, siphonostele: ectophloic, amphiphloic, dictyostele, eustele and atactostele.	
4	<i>Cycas</i> : T.S of leaflet (<i>Cycas</i> pinna)	
5	Megasporophyll, microsporophyll, coralloid root, microspore, L.S. of ovule of <i>Cycas</i> – all specimens to be shown.	
6	Economic importance of Gymnosperms: <i>Pinus</i> (turpentine, wood, seeds)	
7	Leaf morphology : as per theory	
8	Types of inflorescence: as per theory	
9	Malvaceae	
10	Amaryllidaceae	
PRACTICAL Paper II – Form and Function 1		1
1	Primary structure of dicot and monocot root.	
2	Primary structure of dicot and monocot stem.	
3	Study of dicot and monocot stomata.	
4	Epidermal outgrowths: with the help of mountings Unicellular: <i>Gossypium</i> /Radish Multicellular: <i>Lantana</i> /Sunflower Glandular: <i>Drosera</i> and Stinging: <i>Urtica</i> – only identification with the help of permanent slides. Peltate: <i>Thespesia</i> Stellate: <i>Erythrina</i> / <i>Sida acuta</i> / <i>Solanum</i> / <i>Helecteris</i>	

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	T-shaped: <i>Avicennia</i>	
5	Separation of chlorophyll pigments by strip paper chromatography.	
6	Separation of amino acids by paper chromatography.	
7	Change in colour because of change in pH: Anthocyanin: black grapes/Purple cabbage	
8	Test for tannins: tea powder/catechu.	
9	Identification of plants or plant parts for grandma's pouch as per theory.	

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DISTRIBUTION OF TOPICS AND CREDITS
F Y B Sc. BOTANY SEMESTER I

Course	Nomenclature	Credits	Topics
USBO1O1	PLANT DIVERSITY I	02	1. Algae
			2. Fungi
			3. Bryophyta
USBO1O2	FORM AND FUNCTION I	02	1. Cell Biology
			2. Ecology
			3. Genetics
USBOP1	Plant Diversity I, form and Function I (Practical I & II)	02	

F Y B Sc BOTANY SEMESTER II

Course	Nomenclature	Credits	Topics
USBO2O1	PLANT DIVERSITY I	02	1. Pteridophytes
			2. Gymnosperms
			3. Angiosperms
USBO2O2	FORM AND FUNCTION I	02	1. Anatomy
			2. Physiology
			3. Medicinal Botany
USBOP2	Plant Diversity I, Form and Function I (Practical I & II)	02	

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References

1. College Botany Volume I and II Gangulee, Das and Dutta latest edition. Central Education enterprises
2. Cryptogamic Botany Volume I and II by G M Smith McGraw Hill.
3. Genetics by Russel. Wesley Longman inc publishers. (5th edition)
4. Plant Physiology by Taiz and Zeiger Sinauer Associates inc. publishers
5. Fundamentals of Ecology by E P Odum and G W Barrett. Thompson Asia Pvt Ltd. Singapore.
6. Cell Biology by De Robertis

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Scheme of Examinations

Internal and External Assessment as per CBSS of University of Mumbai

Note:

- Two short field excursions for habitat studies are compulsory.
Field work of not less than eight hours duration is equivalent to one period per week for a batch of 15 students.
- A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of F.Y.B.Sc. Botany or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of F.Y.B.Sc. Botany as per the minimum requirements. In case of loss of journal a candidate must produce a certificate from the Head of the department /Institute that the practicals for the academic year were completed by the student. However such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.