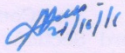


UNIVERSITY OF MUMBAI
No. UG/ 84 of 2016-17

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

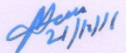
No. UG/84-A of 2016

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"> Dyes and stains: Types, Physicochemical basis Fixatives, Mordants, Decolorizers Simple and differential staining 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"> Dry & moist heat – mechanisms, instruments used and their operations Electromagnetic radiations – Ionizing radiations, mechanisms –advantages & disadvantages Bacteria proof filters Low temperature Osmotic pressure Desiccation <p>2.4 Chemical methods of microbial control - mechanism & advantages & disadvantages (if any) applications.</p> <ol style="list-style-type: none"> Phenolics Alcohols Heavy metals and their compounds Halogens Quaternary ammonium compounds Halogens Dyes Surfaces active agents/Detergents Aldehydes Peroxygens Sterilizing gases 		

	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