AC Item No.

UNIVERSITY OF MUMBAI

Revised Syllabus for T.Y.B.Sc.
Program: B.Sc.
Course: Microbiology (USMB)

(Credit Based Semester and Grading System with effect from the academic year 2018 – 2019)

PREAMBLE

The Choice Based Credit system was introduced by Mumbai University from 2016 - 2017. The process was initiated by restructuring the F.Y.B.Sc. syllabus and the paper pattern according to the CBCS pattern and its implementation in the same year i.e. 2016 - 17.

This was followed by revision of S.Y.B.Sc. syllabus and paper pattern in the year 2017 - 2018.

The revised S.Y.B.Sc. syllabus gave an opportunity to the Microbiology students to opt for Paper III of any subject other than Microbiology. Likewise S.Y.B.Sc. students of other subjects could opt for Microbiology Paper III. This gave them the option to choose from diversity of applied sciences.

In continuation with this, the T.Y.B.Sc. syllabus is being revised in the year 2018 - 2019. The existing paper pattern will also be accordingly revised.

Keeping in tune with the revised syllabus, the committee has ensured that there is a continuous flow of information and latest advances in the subject imparted to the students. Hence some of the modules of the earlier syllabus have been upgraded, while some new modules have been added to the syllabus in order to bridge the knowledge gap of the learner from S.Y.B.Sc. to T.Y.B.Sc.

The syllabus is aimed at equipping the students with basic knowledge in various branches of Microbiology such as Microbial Genetics, Molecular Biology, Virology, Medical Microbiology, Immunology, Microbial Biochemistry and Industrial Microbiology. Additionally, it also makes students aware of interdisciplinary sciences such as Bioinformatics and Bioinstrumentation.

In all, the students offering Microbiology as a single major subject that is Six units pattern, will study eight courses of theory and practicals compulsory during Semester V and Semester VI together, while students opting for double major subject that is Three units pattern, will have four courses of theory and practicals compulsory during Semester V and Semester VI together.

The courses for six units will comprise of the following:

1) USMB 501 and USMB 601
2) USMB 502 and USMB 602
3) USMB 503 and USMB 603
4) USMB 504 and USMB 604

The courses for three units will comprise of the following:

1) USMB 501 and USMB 601
2) USMB 502 and USMB 602

The approach towards designing this syllabus has been to retain the classic concepts of Microbiology as well as keeping abreast with the latest discoveries in Microbiology and other interdisciplinary fields.

In conclusion, the revised syllabus aims at inculcating a spirit of learning and kindling curiosity towards the subject in the minds of learners, resulting in their pursuit of higher education in Microbiology.

T.Y.B.Sc. MICROBIOLOGY THEORY

(SEMESTER V)

COURSE CODE	TITLE	CREDITS AND LECTURES / SEM
USMB501	**Microbial Genetics**	**2.5 Credits (60 Lectures)**
Unit I	DNA Replication	15 Lectures
Unit II	Transcription, Genetic Code & Translation	15 Lectures
Unit III	Mutation and Repair	15 Lectures
Unit IV	Genetic Exchange & Homologous Recombination	15 Lectures
USMB502	**Medical Microbiology & Immunology: Part - I**	**2.5 Credits (60 Lectures)**
Unit I	Bacterial Strategies for Evasion and Study of a Few Diseases	15 Lectures
Unit II	Study of a Few Diseases with Emphasis on Cultural Characteristics of the Etiological agent, Pathogenesis, Laboratory Diagnosis and Prevention.	15 Lectures
Unit III	General Immunology - I	15 Lectures
Unit IV	General Immunology - II	15 Lectures
USMB503	**Microbial Biochemistry: Part - I**	**2.5 Credits (60 Lectures)**
Unit I	Biological Membranes & Transport	15 Lectures
Unit II	Bioenergetics & Bioluminescence	15 Lectures
Unit III	Methods of Studying Metabolism & Catabolism of Carbohydrates	15 Lectures
Unit IV	Fermentative Pathway & Anabolism of Carbohydrates	15 Lectures

USMB504	**Bioprocess Technology: Part - I**	**2.5 Credits (60 Lectures)**
Unit I	Upstream Processing - I	15 Lectures
Unit II	Upstream Processing - II	15 Lectures
Unit III	Fermentation Modes, Equipments and Instruments	15 Lectures
Unit IV	Traditional Industrial Fermentations	15 Lectures

N.B.

I. Each theory period shall be of 48 minutes duration. Theory component shall have 240 instructional periods plus 240 notional periods per semester which is equal to 384 learning hours. For theory component the value of One Credit is equal to 38.40 learning hours.

II. Each practical period shall be of 48 minutes duration. Practical component shall have 240 instructional periods plus 60 notional periods per semester which is equal to 240 learning hours. For practical component the value of One Credit is equal to 40 learning hours.

MICROBIAL BIOCHEMISTRY: PART-I (USMB-503)

LEARNING OBJECTIVES

This course is designed for T.Y.B.Sc. students who choose to major in Microbiology. Biochemistry is the branch of science that explores the chemical processes that take place inside all living things, from bacteria to plants and animals. It is a laboratory based science that brings together biology and chemistry, by using chemical knowledge and techniques to help understand and solve biological problems. Microbial physiology is best understood with knowledge of biochemistry. The course thus focuses on the need to study uptake, various intermediary metabolic processes and methods to study metabolism both invitro as well as invivo. The course is designed to expose students to carbohydrate metabolism as also understand the principles of energy generation by different physiological groups of organisms. The advanced area of bioenergetics unfolds the universal mechanisms of energy generation by using electron transport systems and gaining knowledge of energy conservation. The student is also learning anabolic processes through concepts of biosynthesis, and polymerization namely glycogen and peptidoglycan biosynthesis.

LEARNING OUTCOMES: The students should be able to

- Understand the architecture of the membrane and how solute is transported inside the cell.
- Describe and explain the electron transport chains in prokaryotes and mitochondria and understand the mechanism of ATP synthesis.
- Explain bioluminescence mechanism and its significance
- Discuss the experimental aspect of studying catabolism and anabolism and the various pathways for the breakdown of carbohydrates along with reactions in amphibolic pathways.
- Describe various other pathways which produce different end products.
- Describe anabolic reactions in carbohydrate synthesis.
- Apply the concepts of energetics and catabolism in biodegradation of various substrates.

MICROBIAL BIOCHEMISTRY: PART-I

(USMB-503): DETAIL SYLLABUS

Title	Lectures / Semester	Notional Periods
Unit I: Biological Membranes & Transport	**15 L**	**15**
1.1 Composition and architecture of membrane 1.1.1 Lipids and properties of phospholipid membranes 1.1.2 Integral & peripheral proteins & interactions with lipids 1.1.3 Permeability	**2 L**	

	1.1.4 Aquaporins 1.1.5 Mechanosensitive channels		
1.2	**Methods of studying solute transport** 1.2.1 Use of whole cells 1.2.2 Liposomes 1.2.3 Proteoliposomes	**2 L**	
1.3	**Solute transport across membrane** 1.3.1 Passive transport and facilitated diffusion by membrane proteins 1.3.2 Co-transport across plasma membrane - (Uniport, Antiport, Symport) 1.3.3 Active transport & electrochemical gradient 1.3.4 Ion gradient provides energy for secondary active transport 1.3.4.1 Lactose transport 1.3.5 ATPases and transport (only Na-K ATPase) 1.3.6 Shock sensitive system – Role of binding proteins 1.3.6.1 Maltose uptake (Diagram and description) 1.3.6.2 Histidine uptake (Diagram and description) 1.3.7 Phosphotransferase system 1.3.8 Schematic representation of various membrane transport systems in bacteria.	**8 L**	
1.4	**Other examples of solute transport:** 1.4.1 Iron transport: A special problem 1.4.2 Assembly of proteins into membranes and protein export 1.4.3 Bacterial membrane fusion central to many biological processes	**3 L**	
	Unit II: Bioenergetics & Bioluminescence	**15 L**	**15**
2.1	**Biochemical mechanism of generating ATP:** Substrate-Level-Phosphorylation, Oxidative Phosphorylation & Photophosphorylation	**1 L**	
2.2	**Electron transport chain** 2.2.1 Universal Electron acceptors that transfer electrons to E.T.C. 2.2.2 Carriers in E.T.C. 2.2.2.1 Hydrogen carriers – Flavoproteins, Quinones 2.2.2.2 Electron carriers – Iron Sulphur proteins, Cytochromes. 2.2.3 Mitochondrial ETC 2.2.3.1 Biochemical anatomy of mitochondria 2.2.3.2 Complexes in Mitochondrial ETC 2.2.3.3 Schematic representation of Mitochondrial ETC**.**	**3 L**	
2.3	**Prokaryotic ETC** 2.3.1 Organization of electron carriers in bacteria	**3 L**	

2.3.1.1 Generalized electron transport pathway in bacteria 2.3.1.2 Different terminal oxidases 2.3.2 Branched bacterial ETC 2.3.3 Pattern of electron flow in *E. coli* - aerobic and anaerobic 2.3.4 Pattern of electron flow in *Azotobacter vinelandii*		
2.4 ATP synthesis 2.4.1 Explanation of terms – Proton motive force, Proton pump, Coupling sites, P:O ratio, Redox potential (definition of Standard reduction potential) 2.4.2 Free energy released during electron transfer from NADH to O_2 2.4.3 Chemiosmotic theory (only explanation) 2.4.4 Structure & function of Mitochondrial ATP synthase 2.4.5 Structure of bacterial ATP synthase 2.4.6 Mechanism by Rotational catalysis 2.4.7 Inhibitors of ETC, ATPase and uncouplers	**3 L**	
2.5 Other modes of generation of electrochemical energy 2.5.1 ATP hydrolysis 2.5.2 Oxalate formate exchange 2.5.3 End product efflux, Definition**,** Lactate efflux 2.5.4 Bacteriorhodopsin: - Definition, function as proton pump and significance	**2 L**	
2.6 Bioluminescence 2.6.1 Brief survey of bioluminescent systems 2.6.2 Biochemistry of light emission 2.6.3 Schematic diagram 2.6.4 Significance / Application	**3 L**	
Unit III: Studying Metabolism & Catabolism of Carbohydrates	**15 L**	**15**
3.1 Experimental Analysis of metabolism 3.1.1 Goals of the study 3.1.2 Levels of organization at which metabolism is studied 3.1.3 Metabolic probes. 3.1.4 Use of radioisotopes in biochemistry 3.1.4.1 Pulse labeling 3.1.4.2 Assay and study of radiorespirometry to differentiate EMP & ED 3.1.5 Use of biochemical mutants 3.1.6 Sequential induction	**3 L**	
3.2 Catabolism of Carbohydrates 3.2.1 Breakdown of polysaccharides – Glycogen, Starch, Cellulose 3.2.2 Breakdown of oligosaccharides - Lactose, Maltose, Sucrose, Cellobiose. 3.2.3 Utilization of monosaccharides - Fructose, Galactose	**10 L**	

3.2.4 Major pathways – (with structure and enzymes) 3.2.4.1 Glycolysis (EMP) 3.2.4.2 HMP Pathway - Significance of the pathway 3.2.4.3 ED pathway 3.2.4.4 TCA cycle - Action of PDH, Significance of TCA 3.2.4.5 Incomplete TCA in anaerobic bacteria 3.2.4.6 Anaplerotic reactions 3.2.4.7 Glyoxylate bypass		
3.3 Amphibolic role of EMP; Amphibolic role of TCA cycle	**1 L**	
3.4 Energetics of Glycolysis, TCA and ED pathway – Balance sheet only. Format as in Lehninger (2.5 ATP/NADH and 1.5 ATP / $FADH_2$) (Based on this format make balance sheet for Glycolysis - Lactic acid and Alcohol fermentation and for ED pathway)	**1 L**	
Unit IV: Fermentative Pathways & Anabolism of Carbohydrates	**15 L**	**15**
4.1 Fermentative pathways (with structures and enzymes) 4.1.1 Lactic acid fermentation 4.1.1.1 Homofermentation 4.1.1.2 Heterofermentation 4.1.2 Bifidum pathway 4.1.3 Alcohol fermentation 4.1.3.1 By ED pathway in bacteria 4.1.3.2 By EMP in yeasts	**4 L**	
4.2 Other modes of fermentation in microorganisms 4.2.1 Mixed acid 4.2.2 Butanediol 4.2.3 Butyric acid 4.2.4 Acetone-Butanol 4.2.5 Propionic acid (Acrylate and succinate propionate pathway)	**5 L**	
4.3 Anabolism of Carbohydrates 4.3.1 General pattern of metabolism leading to synthesis of a cell from glucose 4.3.2 Sugar nucleotides 4.3.3 Gluconeogenesis (only bacterial) 4.3.4 Biosynthesis of glycogen 4.3.5 Biosynthesis of Peptidoglycan	**6 L**	

Course Code: USMB503

Text books:

1. Stanier, R. Y., M. Doudoroff and E. A. Adelberg. General Microbiology, 5th edition, The Macmillan press Ltd
2. Conn, E.E., P. K .Stumpf, G. Bruening and R. Y. Doi. 1987. Outlines of Biochemistry, 5th edition, 1987. John Wiley &Sons. New York.
3. Gottschalk,G., (1985), Bacterial Metabolism, 2nd edition, Springer Verlag
4. White, D., (1995), The Physiology and Biochemistry of Prokaryotes, 3rd edition, Oxford University Press
5. Nelson, D. L. and M.M. Cox (2005), Lehninger, Principles of biochemistry. 4th edition, W. H. Freeman and Company
6. Rose, A.H. (1976) Chemical Microbiology, 3rd edition. Butterworth-Heinemann
7. Zubay, G. L (1996), Biochemistry, 4th edition, Wm. C. Brown publishers
8. Mathews, C.K., K.E. van Holde, D.R. Appling, S, J, Anthony-Cahill (2012) Biochemistry, 4th edition. Pearson
9. Wilson and Walker, 4th edition Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University press.

Reference books:

1. Zubay, G. L (1996), Principles of Biochemistry, Wm. C. Brown publishers
2. Cohen, G.N. (2011). Microbial Biochemistry. 2nd edition, Springer

MICROBIAL BIOCHEMISTRY: PART-II

(USMB-603)

LEARNING OBJECTIVES

Having studied many aspects of microbial physiology in the earlier semester, contents of this semester is designed to understand how myriad organic compounds such as lipids, carbohydrates, proteins and nucleic acids can be utilized by the living cells. These life mechanisms also reveal how biomolecules are synthesized. Since all biosynthetic pathways are denovo or salvage, the vital regulatory role played by enzymes is understood. Various levels and mechanisms of regulation are dealt to make the learner aware of coordinated mechanisms of metabolism in the living cell. Photosynthesis is studied to understand the diversity in mechanism of its electron transfer, pigments and localization of photosynthetic apparatus, although the energy conservation mechanism is not different. Microorganisms are diverse with respect to their metabolism and the field of lithotrophy explains how some universal inorganic compounds can be used to make constituents of cell biomass yet others use them as electron acceptors or reduced compounds as source of energy.

LEARNING OUTCOMES: At the end of the course in Microbial Biochemistry; USMB 603, the learner will have an understanding of the following metabolic process and their significance.

- Metabolism of Lipids, Fatty acids, Nucleotides and Amino acids
- Catabolism of Protein and aliphatic hydrocarbons
- Regulation of metabolic process at various levels
- Photosynthesis
- Metabolism of inorganic molecules with special reference to nitrate and sulfate
- Biological Nitrogen fixation
- Lithotrophy

At the end of the course the learner will also acquire the following practical skills

- Screening of microorganisms producing lipase, PHB and protease
- Detection of activity of enzymes which play an important role in amino acid and nitrate metabolism
- Quantitative detection of important metabolic products such as protein and uric acid.
- Quantitative detection of an important metabolic enzymes- protease

MICROBIAL BIOCHEMISTRY: PART-II

(USMB-603): DETAIL SYLLABUS

Title	Lectures / Semester	Notional Periods
Unit I: Lipid Metabolism & Catabolism of Hydrocarbons	**15 L**	**15**
1.1 Introduction to Lipids 1.1.1 Lipids –Definition, classification & functions 1.1.2 Types and role of fatty acids found in bacteria 1.1.3 Common phosphoglycerides in bacteria 1.1.4 Action of lipases on triglycerides /tripalmitate	**2 L**	
1.2 Catabolism of Fatty Acids and PHB 1.2.1 Oxidation of saturated fatty acid by β oxidation pathway 1.2.2 Energetics of β oxidation of Palmitic acid 1.2.3 Oxidation of propionyl CoA by acrylyl- CoA pathway and methylcitrate pathway 1.2.4 PHB as a food reserve and its degradation	**5 L**	
1.3 Anabolism of Fatty Acids & Lipids 1.3.1 Biosynthesis of straight chain even carbon saturated fatty acid (palmitic acid) 1.3.2 Biosynthesis of phosphoglycerides in bacteria 1.3.3 Biosynthesis of PHB	**6 L**	
1.4 Catabolism of aliphatic hydrocarbons 1.4.1 Organisms degrading aliphatic hydrocarbons 1.4.2 Hydrocarbon uptake mechanisms 1.4.3 Omega oxidation pathway- 1.4.3.1 Pathway in *Corynebacterium* and yeast 1.4.3.2 Pathway in *Pseudomonas*	**2 L**	
Unit II: Metabolism of Proteins and Nucleic Acids	**15 L**	**15**
2.1 Protein / amino acid catabolism 2.1.1 Enzymatic degradation of proteins 2.1.2 General reactions of amino acids catalyzed by 2.1.2.1 Amino acid decarboxylases 2.1.2.2 Amino acid deaminases 2.1.2.3 Amino acid transaminases 2.1.2.4 Amino acid racemases 2.1.3 Metabolic fate of amino acids - Glucogenic and ketogenic amino acids 2.1.4 Fermentation of single amino acid - Glutamic acid by *Clostridium tetanomorphum* 2.1.5 Fermentation of pair of amino acids -Stickland reaction (include enzymes)	**6 L**	

2.2 Anabolism of amino acids 2.2.1 Schematic representation of amino acid families 2.2.2 Biosynthesis of amino acids of Serine family (Serine, Glycine and Cysteine)	**2 L**	
2.3 Catabolism of Nucleotides 2.3.1 Degradation of purine nucleotides up to uric acid formation 2.3.2 Salvage pathway for purine and pyrimidine nucleotides	**3 L**	
2.4 Biosynthesis of nucleotides 2.4.1 Nomenclature and structure of nucleotides 2.4.2 Role of nucleotides (high energy triphosphates) 2.4.3 Biosynthesis of pyrimidine nucleotides 2.4.4 Biosynthesis of purine nucleotides 2.4.5 Biosynthesis of deoxyribonucleotides	**4 L**	
Unit III: Metabolic Regulation	**15 L**	**15**
3.1 Definition of terms and major modes of regulation	**2 L**	
3.2 Regulation of enzyme activity 3.2.1 Noncovalent enzyme inhibition 3.2.1.1 Allosteric enzymes and feedback inhibition 3.2.1.2 Patterns of FBI, combined activation and inhibition 3.2.2 Covalent modification of enzymes 3.2.2.1 Monocyclic cascades 3.2.2.2 Examples of covalent modification(without structures) 3.2.2.3 Regulation of Glutamine synthetase	**5 L**	
3.3 DNA binding proteins and regulation of transcription by positive & negative control 3.3.1 DNA binding proteins 3.3.2 Negative control of transcription: Repression and Induction 3.3.3 Positive control of transcription: Maltose catabolism in *E. coli*	**4 L**	
3.4 Global regulatory mechanisms 3.4.1 Global control & catabolite repression 3.4.2 Stringent response	**2 L**	
3.5 Regulation of EMP and TCA cycle - (Schematic and Regulation of Pryruvate dehydrogenase Complex)	**2 L**	
Unit IV: Prokaryotic Photosynthesis & Inorganic Metabolism	**15 L**	**15**
4.1 Photosynthesis 4.1.1 Definition of terms in photosynthesis (light and dark reactions, Hill reaction & reagent, Photophosphorylation) 4.1.2 Photosynthetic pigments 4.1.3 Location of photochemical apparatus 4.1.4 Photochemical generation of reductant	**4 L**	

4.2 Light reactions in: 4.2.1 Purple photosynthetic bacteria 4.2.2 Green sulphur bacteria 4.2.3 Cyanobacteria (with details)	**3 L**	
4.3 Dark reaction 4.3.1 Calvin Benson cycle 4.3.2 Reductive TCA cycle	**2 L**	
4.4 Inorganic Metabolism 4.4.1 Assimilatory pathways: 4.4.1.1 Assimilation of nitrate, 4.4.1.2 Ammonia fixation – Glutamate dehydrogenase, Glutamine synthetase, GS-GOGAT, Carbamoyl phosphate synthetase 4.4.1.3 Biological nitrogen fixation (Mechanism for N_2 fixation and protection of nitrogenase) 4.4.1.4 Assimilation of sulphate 4.4.2 Dissimilatory pathways: 4.4.2.1 Nitrate as an electron acceptor (Denitrification in *Paracoccus denitrificans*) 4.4.2.2 Sulphate as an electron acceptor	**5 L**	
4.5 Lithotrophy–Enlist organisms and products formed during oxidation of Hydrogen, carbon monoxide, Ammonia, Nitrite, Sulphur, Iron.	**1 L**	

Course Code: USMB603

Text books:

1. Stanier, R. Y., M. Doudoroff and E. A. Adelberg. General Microbiology, 5th edition, The Macmillan press Ltd.
2. Conn, E.E., P. K. Stumpf, G. Bruening and R. Y. Doi. 1987. Outlines of Biochemistry, 5th edition, 1987. John Wiley & Sons. New York.
3. Gottschalk, G., (1985), Bacterial Metabolism, 2nd edition, Springer Verlag
4. White, D., (1995), The Physiology and Biochemistry of Prokaryotes, 3rd edition, Oxford University Press
5. Nelson, D. L. and M.M. Cox (2005), Lehninger, Principles of biochemistry, 4th edition, W. H. Freeman and Company.
6. G. Moat, J.W. Foster, M, P. Spector. (2002), Microbial Physiology, 4th edition, WILEY-LISS
7. Madigan, M.T. and J.M. Martinko2006. 11th edition, Brock Biology of Microorganisms. Pearson Prentice Hall.

Reference books:

1. Zubay, G. L (1996), Biochemistry, 4th edition, Wm. C. Brown publishers
2. Zubay, G. L (1996), Principles of Biochemistry, Wm. C. Brown publishers
3. Principles of Biochemistry, Lehninger, 5th edition, W. H. Freeman and Company

Course Code: USMB604

Text books

1. Casida L. E., "Industrial Microbiology" (2009) Reprint, New Age International (P) Ltd, Publishers, New Delhi.
2. Stanbury P. F., Whitaker A. & Hall S. J., (1997), "Principles of Fermentation Technology", 2nd Edition, Aditya Books Pvt. Ltd, New Delhi.
3. Stanbury P. F., Whitaker A. & Hall S. J 3rd edition (2017) "Principles of Fermentation Technology"
4. H. K. Das., "Text book of Biotechnology", 2nd and 3rd edition.
5. A textbook of biotechnology R. C. Dubey 4th edition. S. Chand.
6. H. A. Modi, (2009). ''Fermentation Technology'' Vol. 1 & 2, Pointer Publications, India
7. Okafor Nduka (2007) ''Modern Industrial Microbiology and Biotechnology'', Science Publications Enfield, NH, USA.
8. Crueger W. and Crueger A. (2000) "Biotechnology -"A Textbook of Industrial
9. Microbiology", 2nd edition, Panima Publishing Corporation, New Delhi.
10. Prescott and Dunn's ''Industrial Microbiology'' (1982) 4th edition, McMillan Publishers.
11. Veerakumari L. "Bioinstrumentation", MJP Publisher
12. Pharmaceutical Microbiology, Hugo and Russell, 7th edition, Blackwell Science.

Reference books

1. Peppler, H. J. and Perlman, D. (1979), "Microbial Technology''. Vol 1 & 2, Academic Press.
2. Williams, Bryan L; Wilson, 2nd edition." A Biologist's guide to principles and techniques of practical biochemistry" Baltimore: University Park Press, 1981.
3. Wilson, Keith, 1936-; Goulding, Kenneth H, 3rd edition., A Biologist's guide to principles and techniques of practical biochemistry" London ; Baltimore : E. Arnold, 1986.
4. Wilson and Walker, "Principles and techniques of practical biochemistry" 5th edition.

Semester V:

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 the Head of the Department / Co-ordinator of the department; failing which the student will not be allowed to appear for the practical examination.

Semester VI

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 the Head of the Department/ Co-ordinator of the department; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

Course code	Practical Syllabus	Credits & lectures
USMBP05	Based on USMB501 and USMB502 of Semester V	Credits 3 (8 periods/week) = 120 periods/semester
USMBP06	Based on USMB503 and USMB504 of Semester V	Credits 3 (8 periods/week) = 120 periods/semester

Semester V

Course	USMB-501	USMB-502	USMB-503	USMB-504	Grand Total
Theory	**100**	**100**	**100**	**100**	**400**
Practicals	**50**	**50**	**50**	**50**	**200**

Semester VI

Course	USMB-601	USMB-602	USMB-603	USMB-604	Grand Total
Theory	**100**	**100**	**100**	**100**	**400**
Practicals	**50**	**50**	**50**	**50**	**200**

T.Y.B.Sc. Microbiology Practicals: Semester-V

Course code	Practical Syllabus	Credits & lectures
USMBP05	Based on USMB501 and USMB502 of Semester V	Credits 3 (8 periods/week) = 120 periods/semester
USMBP06	Based on USMB503 and USMB504 of Semester V	Credits 3 (8 periods/week) = 120 periods/semester

T.Y.B.Sc. Microbiology Practicals: Semester-VI

Course code	Practical Syllabus	Credits & lectures
USMBP07	Based on USMB601 and USMB602 of Semester VI	Credits 3 (8 periods/week) = 120 periods/semester
USMBP08	Based on USMB603 and USMB604 of Semester VI	Credits 3 (8 periods/week) = 120 periods/semester

COURSE WISE CREDIT ASSIGNMENT UNDER THE FACULTY OF SCIENCE

Program: B.Sc.
Course: Microbiology (USMB)

Course wise credit assignments under the faculty of science Type of Courses / Credits Assigned	**First Year (Credit x No. of Courses)**		**Second Year (Credit x No. of Courses)**		**Third Year (Credit x No. of Courses)**		**Total Credit Value**
	First Semester	**Second Semester**	**Third Semester**	**Fourth Semester**	**Fifth Semester**	**Sixth Semester**	
Core Courses (Theory)	04x03	04x03	06x02	06x02	2.5x04	2.5x04	68
Core Courses (Practicals)	02x03	02x03	03x02	03x02	1.5x04	1.5x04	36
Foundation course	02x01	02x01	02x01	02x01			08
Applied Component Courses (Theory)					02x01	02x01	04
Applied Component Courses (Practical)					02x01	02x01	04
Total	**20**	**20**	**20**	**20**	**20**	**20**	**120**