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.

BIOPROCESS TECHNOLOGY: PART-I (USMB-504)

LEARNING OBJECTIVES

Bioprocess Technology I course is designed to develop the learner's ability to study the techniques used in the different phases of industrial microbiology such as strain improvement, basic fermentation equipment & its sterilization aspects. It gives an in depth focus of the different types of fermenters used in industry for production of different products, and also emphasizes its process parameters. It includes the principles and describes the main steps and processes in the industrial production of beverages and enzymes.

Industrial microbiology becomes an important application based paper covering microbial fermentations. Thus, it becomes a laboratory to market scenario where the entire products reach. The learner is provided with the details of productions of important traditional fermentation products like wine, beer, vinegar and enzymes.

Thus, this paper readies the learner to understand and apply the knowledge of fermentation technology and related products.

This course aims to enable graduates to enter industry with an appropriate level of understanding of the need for both the science and business aspects to be achievable to make a viable product and enhance their entrepreneur skills.

LEARNING OUTCOMES: The students should be able to

- Describe the applications of microbes and its strain improvement in Industrial Microbiology.
- Apply kinetic formula to determine growth and productivity parameters of batch continuous, fed batch and solid substrate fermentations
- Describe the design of bioreactors for different applications and its process parameters
- Design media, growth conditions and techniques for producing and recovering different types of products of commercial value.
- Learner will be well –versed with the containment and levels of containment.

BIOPROCESS TECHNOLOGY: PART-I

(USMB-504): DETAIL SYLLABUS

Title	Lectures / Semester	Notional Periods
Unit I: Upstream Processing – I	**15 L**	**15**
1.1 Introduction 1.1.1 An introduction to fermentation processes 1.1.2 The range of fermentation processes 1.1.3 The Component parts of a fermentation process	**3 L**	
1.2 Screening methods 1.2.1 Primary and secondary screening	**3 L**	

	1.2.2 High throughput screening methods		
1.3	**Strain improvement** 1.3.1 The improvement of industrial microorganisms 1.3.2 The selection of induced mutants synthesizing improved levels of primary metabolites 1.3.3 The isolation of induced mutants producing improved yields of secondary metabolites. 1.3.4 The improvement of strains by modifying properties other than the yield of product	**6 L**	
1.4	**Preservation of cultures** 1.4.1 Preservation of industrially important organisms 1.4.2 Quality control of preserved stock 1.4.2.1. Key Criteria's 1.4.2.2. Development of a master culture bank (MCB) 1.4.2.3. Variability test to ensure reproducibility of the MCB	**3 L**	
	Unit II: Upstream Processing – II	**15 L**	**15**
2.1	**Fermentation media formulation and raw materials** 2.1.1 Media formulation 2.1.2 Raw materials for fermentation media	**4 L**	
2.3	**The development of inocula for industrial fermentations** 2.2.1 Introduction 2.2.2 Development of inocula for unicellular bacterial process 2.2.3 Development of inocula for mycelial process	**3 L**	
2.3	**Sterilization and achievement of aseptic conditions** 2.3.1 Introduction 2.3.2 Medium sterilization (concept of nabla factor) 2.3.3 Methods of batch sterilization 2.3.4 The design of continuous sterilization process 2.3.5 Sterilization of the Fermenter 2.3.6 Sterilization of the Feeds 2.3.7 Sterilization of the liquid wastes 2.3.8 Filter Sterilization 2.3.8.1 Filter sterilization of fermentation media, 2.3.8.2 Filter sterilization of air 2.3.8.3 Filter sterilization of fermenter exhaust air 2.3.9 Achievement of aseptic conditions	**6 L**	
2.4	**Scale up and scale down of fermentation**	**2 L**	
	Unit III: Fermentation Modes, Equipments and Instruments	**15 L**	**15**
3.1	**Modes of fermentation** 3.1.1 Batch, continuous and fed batch fermentation 3.1.2 Solid substrate fermentation	**3 L**	

3.2	**Design of fermenter** 3.2.1 Basic functions 3.2.2 Aseptic operation & Containment 3.2.3 Body construction 3.2.4 Agitator (impeller) – function, types, mechanical seal and magnetic drive 3.2.5 Baffles 3.2.6 The aeration system (sparger) - function and types 3.2.7 Valves (Globe, piston & needle) 3.2.8 Steam traps 3.2.9 Examples of fermenters - Stirred Tank Reactor, Air Lift, Deep Jet, Photobioreactor	**7 L**	
3.3	**Instrumentation and control** 3.3.1 Introduction to sensors and its types 3.3.2 Measurement and control of: pH, temperature, pressure, foam sensing, dissolved oxygen, inlet and exit gas analysis.	**5 L**	
	Unit IV: Traditional Fermentations	**15 L**	**15**
4.1	**Wine – Red, White, Champagne and Sherry:** Alcoholic fermentation, composition of grape juice, Sulphur dioxide addition, factors affecting wine fermentation, examples and role of yeasts involved in fermentation, malolactic fermentation, technological aspects of wine making- red, white, champagne, sherry, examples of aroma compounds of wine, types and examples of wine	**3 L**	
4.2	**Beer – Ale and Lager:** Elements of brewing process, process details, use of cylindro-conical vessel, primary fermentation, continuous fermentation, aging and finishing, yeasts involved in fermentation.	**3 L**	
4.3	**Alcohol from Molasses:** Introduction, biosynthesis of ethanol, production process- preparation of nutrient solution, fermentation, recovery by distillation**.**	**2 L**	
4.4	**Vinegar (acetic acid):** Introduction, biosynthesis, production using generator, production using submerged fermenter, recovery**.**	**3 L**	
4.5	**Baker's yeast:** Outline of production, yeast strains and their properties, factors important in production-oxygen requirement and aeration, concentration of sugar, pH, temperature, preparation of substrate, fermentation, harvesting of yeast cells, production of compressed and active dry yeast.	**2 L**	
4.6	**Fungal amylase production:** $\propto$ amylase- production from bacteria and fungi, β amylase and glucoamylase, concentration and purification.	**2 L**	

Course Code: USMB504

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. Peppler, H. J. and Perlman, D. (1979), "Microbial Technology''. Vol. 1 & 2, Academic Press
5. H. A. Modi, (2009). ''Fermentation Technology'' Vol. 1 & 2, Pointer Publications, India.
6. Okafor Nduka (2007) ''Modern Industrial Microbiology and Biotechnology'', Science Publications Enfield, NH, USA.
7. Crueger W. and Crueger A. (2000) "Biotechnology -"A Textbook of Industrial
8. Microbiology", 2nd edition, Panima Publishing Corporation, New Delhi.
9. Prescott and Dunn's ''Industrial Microbiology''(1982) 4th edition, McMillan Publishers

Reference books

1. R. C. Dubey, 2005 A Textbook of ''Biotechnology'' S. Chand and Company, New Delhi.
2. H. A. Modi, 2009. ''Fermentation Technology'' Vol: 1 & 2, Pointer Publications, India
3. Practical Fermentation Technology by Brian Mcneil & Linda M. Harvey (2008).

T.Y.B.Sc. MICROBIOLOGY THEORY

(SEMESTER VI)

COURSE CODE	TITLE	CREDITS AND LECTURES / SEM
USMB601	**rDNA Technology, Bioinformatics & Virology**	**2.5 Credits (60 Lectures)**
Unit I	Recombinant DNA Technology	15 Lectures
Unit II	Applications of rDNA Technology & Bioinformatics	15 Lectures
Unit III	Regulation & Basic Virology	15 Lectures
Unit IV	Advanced Virology	15 Lectures
USMB602	**Medical Microbiology & Immunology: Part - II**	**2.5 Credits (60 Lectures)**
Unit I	Study of a Few Diseases with Emphasis on Cultural Characteristics of the Etiological Agent, Pathogenesis, Laboratory Diagnosis and Prevention.	15 Lectures
Unit II	Chemotherapy of Infectious Agents	15 Lectures
Unit III	Immunology - I	15 Lectures
Unit IV	Immunology – II	15 Lectures
USMB603	**Microbial Biochemistry: Part - II**	**2.5 Credits (60 Lectures)**
Unit I	Lipid Metabolism & Catabolism of Hydrocarbons	15 Lectures
Unit II	Metabolism of Proteins and Nucleic Acids.	15 Lectures
Unit III	Metabolic Regulation	15 Lectures
Unit IV	Prokaryotic Photosynthesis & Inorganic Metabolism	15 Lectures
USMB604	**Bioprocess Technology: Part - II**	**2.5 Credits (60 Lectures)**
Unit I	Downstream Processing	15 Lectures
Unit II	Advances in Bioprocess Technology	15 Lectures
Unit III	Quality Assurance, Quality Control, Instrumentation and Bioassay	15 Lectures
Unit IV	Industrial Fermentations	15 Lectures

LEARNING OBJECTIVES

Bioprocess Technology II is designed to develop the learner's ability to study the techniques use in the downstream process used for the final product and industrial effluent treatment.

Bioprocess technology II becomes an important application based paper covering microbial fermentations as well as applying the techniques of molecular biology to enzyme technology, animal tissue culture as well as plant tissue culture. Thus, it becomes a laboratory to market scenario where the entire products reach. The learner is provided with the details of productions of important products like antibiotics, vitamins, organic acid, amino acids and mushrooms along with the analysis techniques using various instruments and bioassays.

The learner is expected to learn the need of Quality management and regulatory bodies as the products need to fulfill these requirements. Thus, this paper readies the learner to understand and apply the knowledge of fermentation technology and related products. This course aims to enable graduates to enter industry with an appropriate level of understanding of the need for both the science and business aspects to be achievable to make a viable product and enhance their enterpreunial skills.

LEARNING OUTCOMES:

- Understand the actual process involved in fermentations of important products.
- To apply the knowledge of applications of animal and plant tissue culture techniques.
- Learn the applications of immobilized enzymes in various fields.
- Understand the working of important instruments used in biochemical analysis and bioassay.
- Learn the salient features of quality management and regulatory procedures.

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

- Techniques involved in running a bioassay, immobilization of cells & sterility testing
- Preliminary techniques in animal & plant tissue culture.

BIOPROCESS TECHNOLOGY: PART-II

(USMB-504): DETAIL SYLLABUS

Title	Lectures / Semester	Notional Periods
Unit I: Downstream Processing	**15 L**	**15**
1.1 Recovery and purification 1.1.1 Introduction 1.1.2 Methods of DSP: Precipitation, Filtration, Centrifugation, Cell Disruption, Liquid-Liquid Extraction, Solvent Recovery, Chromatography, Membrane Processes, Drying, Crystallization, Whole Broth Processing	**10 L**	
1.2 Effluent treatment – Introduction, Dissolved oxygen concentration as indicator of water quality, The strength of fermentation effluents, Treatment process (Physical, chemical and biological)	**5 L**	
Unit II: Advances in Bioprocess Technology	**15 L**	**15**
2.1 Animal biotechnology 2.1.1 Primary cell culture and established cell lines 2.1.2 Basic principles 2.1.3 Growth media 2.1.4 Cell viability 2.1.5 Scale up of cultured cells and tissue 2.1.6 Applications of cell culture: Vaccines, somatic cell fusion, valuable products.	**5 L**	
2.2 Plant tissue culture 2.2.1 Introduction	**5 L**	

2.2.2 Requirements for in vitro culture, Methods of plant cell and tissue culture 2.2.3 Types of cultures of plant materials: explants, callus, organogenesis, root culture, shoot culture, micropropogation, suspension culture, protoplast culture, protoplast fusion and somatic hybridization**.** 2.2.4 Applications: production of disease resistant plants, production of virus free plant, In vitro selection of cell lines for disease resistance, micropropogation, secondary metabolites from cell culture, transgenic plants for crop improvement **2.3 Immobilized enzyme and cells** 2.3.1 Introduction and Definitions 2.3.2 Methods 2.3.3 Immobilized Enzyme Reactors 2.3.4 Applications	**5 L**	
Unit III: Quality Assurance, Quality Control, Instrumentation and Bioassay	**15 L**	**15**
3.1 Quality assurance and quality control 3.1.1 Definitions, Chemical and pharmaceutical products 3.1.2 Variables of batch process 3.1.3 Q.A and Q.C wrt.- Raw materials, method of manufacturing, in process items, finished products, label and labeling, packaging materials 3.1.4 Control of microbial contamination during manufacturing	**4 L**	
3.2 Sterilization control and assurance	**2 L**	
3.3 Instrumentation: Principles, working and application of 3.3.1 Spectrophotometry: UV, Visible & IR 3.3.2 AAS & AES (Flame photometry)	**3 L**	
3.4 Bioassay 3.4.1 Introduction 3.4.2 Types: Diffusion, End Point, Turbidometric, Metabolic Response, Enzymatic	**3 L**	
3.5 Intellectual property rights 3.5.1 Genesis, Role of WTO and TRIPS 3.5.2 Overview of patent system 3.5.3 Requirements for patentability 3.5.4 Patent Categories 3.5.5 Preliminary steps for patent applications 3.5.6 Patent Procedures 3.5.7 For biotech and microbiological products	**3 L**	

	Unit IV: Industrial Fermentations	**15 L**	**15**
4.1	**Penicillin and semisynthetic penicillins:** Introduction, biosynthesis and regulation, strain development, production methods. Semisynthetic penicillins: Examples, production, advantages	**3 L**	
4.2	**Aminoglycoside: Streptomycin:** Aminoglycoside antibiotics, biosynthesis, regulation of biosynthesis, strain development, production method, recovery.	**3 L**	
4.3	**Vitamin B $_{12}$:** Occurrence and economic significance,structure, biosynthesis, production based on media containing carbohydrates by- *Propionibacteria* and *Pseudomonas,* recovery.	**2 L**	
4.4	**Citric acid:** Introduction, strains used for production, biosynthesis, nutrient media, production processes- surface and submerged, product recovery.	**3 L**	
4.5	**Glutamic acid:** Production strains, biosynthesis, effect of permeability on production, conditions of manufacturing, production process and recovery.	**2 L**	
4.6	**Mushroom cultivation (Agaricus):** Edible mushroom species, preparation of substrate- composting- phase I and phase II, Factors affecting composting, preparation of spawn, casing, induction of fruiting body formation, harvesting	**2 L**	

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.

Modality of Assessment
Assessment pattern for theory

Scheme of Examination

The learner's Performance shall be assessed by conducting the Semester End Examinations with 100% marks

Semester End Theory Assessment - 100% **100 marks**

1. Duration - These examinations shall be of **3 hours** duration.
2. Theory question paper pattern :-
   i. There shall be **five questions** each of **20** marks (with internal options)
   ii. Question one will be based on unit one, question two on unit two, question three on unit three and question four on unit four. Question five will have questions from all four units of the syllabus.
   iii. Each of the main questions one to four will be subdivided into two sub-questions "A" and "B". Sub-question "A" will have four questions (of 6 marks each) out of which any two will be attempted. Total marks allotted to sub-question "A" will be 12 marks. Sub-question "B" will be 'Do as directed (attempt eight out of twelve)'. Each question in Sub-question "B" will be of one mark each. Total marks allotted to "B" sub-question will be 8 marks. Main question five will have six questions (of 5 marks each) out of which any four will be attempted, total 20 marks.
   iv. All questions shall be **compulsory** with internal choice within the questions.
   v. The allocation of marks will depend on the weightage of the topic.

Passing Standard:

The learners to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course and 40% marks in **Semester End Examination (i.e. 40 out of 100) separately**, to pass the course and **minimum of Grade E** in each project, wherever applicable, to pass a particular semester.

Practical Examination Pattern:

External (Semester end practical examination):-

Sr.No.	Particulars/ paper	Marks
1.	Laboratory work	40
2.	Journal	05
3.	Viva	05

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**