Academic Council Meeting No. and Date : 8 / September 04, 2023

Agenda Number : 2 Resolution Number : 34, 35 / 2.9, 2.30

Vidya Prasarak Mandal's

B. N. Bandodkar College of Science (Autonomous), Thane

Syllabus for

Programme : Bachelor of Science

Specific Programme : Microbiology

[F.Y.B.Sc. Microbiology]

Level 4.5

CHOICE BASED GRADING SYSTEM

Revised under NEP

From academic year 2023 - 2024

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Preamble

Microbiology is an ever-evolving branch of biology that includes the study that utilizes Microbial systems, to develop or create different products for betterment of society. Under-graduate (UG) program in Microbiology offers opportunity for students to learn fundamental microbiology, biochemistry, immunology, genetics, molecular biology and their applications in various industries like food, agriculture, dairy, health care etc. With the goal of engaging the learners in learning basic concepts in microbiology and acquaint them with current developments in the field that can be correlated better with the theoretical learning, the syllabus was re-framed under autonomy. Continuing the Choice Based Credit System (CBCS) implemented by the esteemed University of Mumbai from the academic year 2016-2017, the existing syllabus of F.Y.B.Sc. Microbiology is restructured according to the NEP reforms for its effective implementation from 2023-24 under the autonomous status of VPM's B. N. Bandodkar College of Science.

BOS Chairman: Dr. Kalpita Muley

Eligibility: Passed 12th standard (HSC) of Maharashtra State Board/ CBSE/ ICSE board

Discipline/Subject: Microbiology

Name of the Degree Program: B.Sc.

Level: 4.5

Duration: 1 Year (includes SEM I and SEM II)

Eligibility For certificate if exit at level 4.5

Mode of Conduct: Offline (Offline lectures & Laboratory Practicals)

Total Credits for the Program: 176

Starting year of implementation: 2023- 24

Specific Programme: F.Y.B.Sc. (Subject (Major) Credits: 06

Program Specific Outcome:

By the end of the program the students will be able to:

Apply basic knowledge of fundamental microbiology, microbial biochemistry, genetics, immunology, cytology, along with various microbiological techniques to make positive use of microbial systems for betterment of community and for sustainable development.

VPM's B.N.Bandodkar College of Science (Autonomous), Thane

F.Y.B.Sc.

Curriculum Structure for the Undergraduate Degree Program F.Y.B.Sc Microbiology

Structure of Programme

Semester I Major			
Course Code	**Course Title**	**No. of lectures in hours**	**Credits**
23BUMB1T1	Fundamental Microbiology I	**30**	**2**
23BUMB1T2	Fundamental Microbiology II	**30**	**2**
23BUMB1P1	Practicals based on 23BUMB1T1and 23BUMB1T2	**60**	**2**
23BU1VSC7	Laboratory techniques in Microbiology	**45**	**2**
	Total	**165**	**8**
Semester I Minor			
Course Code	**Course Title**	**No. of lectures In hrs**	**Credits**
23BUCH1T3	Chemistry -Minor 1	**30**	**2**
23BUCH1T4	Chemistry - Minor 2	**30**	**2**
23BUMB1P2	Chemistry Practicals	**60**	**2**
	Total	**120**	**6**
Semester I: Generic			
23BUMB1T5	Statistic/ Zoology (Generic-1)	**30**	**2**
	Total	**30**	**2**
Semester 1 **Optional Electives -Interdisciplinary Sciences**			
23BUID1T6	**Soft skills and personality development-I**	**30**	**2**
	Total	**30**	**2**
Semester 1 - (AEC)			
23BUEN1T8	**Basic English Learning course**	**30**	**2**

	Total	**30**	**2**
Semester 1 - Indian Knowledge System			
23BUIK1T9	Ayurveda for Healthy Lifestyle	**30**	**2**
	Total	**30**	**2**
Semester II			
Course Code	**Course Title**	**No. of lectures in hours**	**Credits**
23BUMB2T1	Exploring Microbiology I	**30**	**2**
23BUMB2T2	Exploring Microbiology II	**30**	**2**
23BUMB2P1	Practicals based on 23BUMB2T1 and 23BUMB2T2	**60**	**2**
23BU2CC07	CC	**30**	**2**
23BU2CC01	NSS-Social science		
23BU2CC02	NCC-Defense science		
23BU2CC03	DLLE		
23BU2CC04	Sports- Physical Education		
23BU2CC05	Culture		
Total		**150**	**8**
Semester 2: Minor			
Course Code	**Course Title**	**No. of lectures In hrs**	**Credits**
23BUMB2T3	Chemistry Minor 1	**30**	**2**
23BUMB2T4	Chemistry Minor 2	**30**	**2**
23BUMB2P2	Chemistry Practicals	**60**	**2**
	Total	**120**	**6**
Semester 2: Generic			
23BUMB2T5	Statistic/ zoology (Generic-2)	**30**	**2**
	Total	**30**	**2**
Semester 2 **Optional electives Interdisciplinary sciences**			
23BUID2T6	**Soft skills and personality**	**30**	**2**

	development-II		
	Total	**30**	**2**
Semester 2 (AEC)			
23BUEN2T8	**Scientific *English Writing***	**30**	**2**
	Total	**30**	**2**
Semester 2- Indian Knowledge System			
23BUIK2T9	Principles of Yoga for Body and Mind Management	30	2
	Total	**30**	**2**

Note: Minor - Chemistry, Generic, statistics/zoology AEC, IKS, Open elective syllabus view separately.

Semester I

Course Code 23BUMB1T1	Course Title Fundamental Microbiology I	Credits 2	No. of lectures
Learning Outcomes: Learner will be able to: • Obtain knowledge about the structural details of prokaryotic cell organelles,genetic material, and other components along with their function • Enlist the nutritional requirements of bacteria and their nutritional types. • Describe procedure for cultivation, preservation and collection of microbial cultures.			
Unit I:Prokaryotic cell structure	• Prokaryotic cell structure: Overview (Size, shape, arrangement) • Ultra structure of prokaryotic cell: bacterial and archaeal - cell wall and cell membrane. • Components external to cell wall - capsule, slime layer, s-layer, pili, fimbriae, flagella: structure, motility, chemotaxis. • Cytoplasmic matrix - ribosome, magnetosomes, peroxisomes, mesosomes • Inclusion granules: Composition and function. • Nuclear Material – bacterial structure (its differences with the eukaryotic chromosome); • Extra Chromosomal material. • Bacterial Endospore - Examples of spore forming organisms, habitats, function, formation and germination. • Reproduction in bacteria • Difference between prokaryotic and eukaryotic cell structure		**15**
Unit II: Microbial nutrition	• Nutritional requirements – Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors (definition only) • Nutritional types of microorganisms • Types of Culture media with examples • Isolation of microorganisms and pure culture techniques • Cultivation of anaerobic microorganisms • Preservation of microorganisms • Culture Collection Centers		**15**

Course Code 23BUMB1T2	Course Title Fundamental Microbiology II	Credits 2	No. of lectures
Learning Outcomes: Learner will be able to: • Understand the detailed mechanism of staining techniques to observe different types ofmicroorganisms • Implement the knowledge acquired, to appropriately identify the microscopic techniques • Comprehend different methods for control of microbes			
Unit I: Microscopy & Staining	**Microscopy:** • History of microscopy, Optical spectrum, Lenses and mirrors • Simple and compound light microscope • Dark field Microscopy • Phase contrast • Foldscope • SEM and TEM **Staining procedures** • Dyes and stains: Types, Physicochemical basis Fixatives, Mordants, Decolorizers • Simple and differential staining • Special staining (Cell wall, Capsule, Lipid granules Spores, Metachromatic granules & Flagella)		**15**
Unit II: Control of microorganisms	Definition of frequently used terms & Rate of microbial death, Factors affecting the effectiveness of antimicrobial agents & Properties of an ideal disinfectant **Physical methods of microbial control** o Dry & moist heat – mechanisms, instruments used and their operations o Electromagnetic (Ionizing) radiations - mechanisms, advantages & disadvantages, importance of cold sterilization o Bacteria proof filters o Low temperature o Osmotic pressure o Desiccation **Chemical methods of microbial control - mechanism & advantages & disadvantages (if any) applications:** o Phenolics o Alcohols o Heavy metals and their compounds o Halogens o Quaternary ammonium compounds o Evaluation of disinfectant –Tube dilution & Agar plate techniques, Phenol coefficient, Tissue toxicity index **Introduction to Chemotherapeutic agents**		

Course Code 23BUMB1P1	Course Title Practical based on 23BUMB1T1 and 23BUMB1T2	Credits 2	No. of lectures in hrs.: 60
Practical 1	**Practicals Based on Unit I of BNBUSMB1T1**		
1	Introduction to Microbiology laboratory set up and good laboratory practices		**3**
2	Special Staining a. Cell Wall b. Capsule c. Endospore		**6**
	Practicals Based on Unit II of BNBUSMB1T1		
3	Preparation of Culture Media: Liquid medium (Nutrient Broth)		**6**
4	Preparation of slant, butts & plates (Aseptic transfer)		**6**
5	Inoculation techniques: Liquid media Solid Media (Slants, Butts and Plates)		**6**
6	Study of Motility (Hanging Drop method& stab culture)		**3**
7	Use of Differential & Selective Media: (MacConkey & Salt Mannitol Agar)		**6**
8	Demonstration of microbial culture preservation		**3**
Practical 2	**Practicals Based on Unit I of BNBUSMB1T2**		
1	Effect of dyes, phenolic compounds and chemotherapeutic agents (Disk diffusion method)		**6**
2	Effect of UV light, osmotic pressure, heavy metals on microbial growth		**6**
	Practicals Based on Unit II of BNBUSMB1T2		
3	Monochrome staining and negative staining		**3**
4	Gram staining		**3**
5	Observing random samples using foldscope		**3**

Course Code 23BUMB1T5	Course Title Majestic Microbial World	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Describe microbial existence and State basic features of microbes • Describe various exclusive habitats • Enlist different products of microbial origin			
Unit I: Introduction to microorganisms	• Introduction to microbes, basic cellular features and function • Uniqueness of Microbes: invisible to infinity • Natural habitats • Nutritional requirements, cultivation • Life of microbes in extreme environments • Microbes with unique abilities • Viable but non culturable (VBNC)		**15**
Unit II: The Good and the Bad	**Good bacteria contributing in** • Food production: fermented foods • Pharmaceutical industry: vaccines, hormones, antibiotics • Nutraceutical industry: prebiotics, probiotics • Agriculture: Biofertilizers, biopesticides **Bad bacteria** • Pathogens • Plant pathogens • Food spoilage • Biodeterioration **Strategies to control them**		**15**

Course Code 23BU1VSC7		Credits 2 (1T +1P)	
Course Code 23BU1VSC7	**Course Title Laboratory techniques in Microbiology**	**Credits 1**	**No. of lectures**
Learning Outcomes: Learners will be able to: • Know and follow good laboratory practices • Demonstrate use and maintenance of basic instruments used in microbiology lab • Gain knowledge about documentation, laboratory maintenance and repair reports			
Unit I	• Methods and practices in microbiology lab • Good clinical practices, Standard operating procedures, good laboratory practices, good manufacturing practices, • Usage and maintenance of basic equipments in microbiology lab: principle, working and calibration • Biosafety norms, Working and significance of LAF • Documentation, laboratory maintenance and repair reports		**15**

Course Code 23BU1VSC7	Course Title Practical based on 23BU1VSC7	Credits 1	No. of lectures in hrs.
1	Methods of preparation of glassware for Sterilization (Pipettes, Petri Plates, Plastic wares, Flasks, Micropipettes)		**3**
2	Demonstration of microbes in air, cough, on table surface, finger tips		**3**
3	Introduction to Laboratory equipments: • Microscope: construction, working, care • Autoclave: principle, construction, working, care, validation • Hot air oven: principle, construction, working, care • Colorimeter: principle, construction, working, care		**12**
4	Determination of λmax and verification of Beer's law.		**6**
5	Variations in Microbiological analysis: Breed's count		**3**
6	Reproducibility of experimental results w.r.t. pH meter		**3**

Course Code 23BUIK1T9	Course Title Indian Knowledge System-I	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Learn basic concepts in Ayurveda related to human body • Understand the importance of Meditation & Stress Management			
Unit I: **Know Your Body**	• Three Gunas& Mental Nature • The Three Doshas • The Seven Dhatus • The Five Pranas		**15**
Unit II: **Meditation & Stress Management**	• Concept of Stress • Stimulation - Relaxation for Stress Management • Dinacharya • Balancing the female cycle • Pranayama & Its forms • Meditation & The Mind • Resolving inner conflict & limiting beliefs 'The Enquiry', Accomplishing goals		**15**

Semester II

Course Code 23BUMB2T1	Course Title Exploring microbiology I	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Be well versed with the various aspects of macromolecules • Describe enumeration of microorganisms using appropriate techniques • Comprehend the effect of various environmental parameters on the growth ofmicroorganisms			
Unit I: Macromolecules	**Water-** Structure, properties in brief **Carbohydrates:** • Definition, Classification, Biological role • Monosaccharides, oligosaccharides (maltose, cellobiose, sucrose, lactose) • Polysaccharide (starch, glycogen, peptidoglycan, cellulose) **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 & proteins- Definition & general features and examples with biological role • Primary, secondary, tertiary, quaternary structures - Brief outline **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 **Lipids and Fatty acids:** • Classification and properties of saturated and unsaturated fatty acids		**15**
Unit II **Microbial Growth**	• Definition of growth, Mathematical Expression, Growth curve • Measurement of growth • Direct microscopic count–Breed's count, Petroff–Hausser counting chamber- Hemocytometer • Viable count – Spread plate and Pour plate technique • Measurements of cell constituents • Turbidity measurements–Nephelometer and spectrophotometer techniques • Synchronous growth, Continuous growth (Chemostat and Turbidostat) • Influence of environmental factors on growth • Microbial growth in natural environment • Counting viable non-culturable organisms-Quorum sensing techniques		**15**

Course Code 23BUMB2T2	Course Title Exploring microbiology II	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Understand basic morphological and structural features of Rickettsia, Archeae Actinomycetes, Algae, Protozoa, Fungi andmolds • Understand various types of interactions of microbes with other living being as well as within the microbial world and their applications			
Unit I: Microbial Diversity	• 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. • Rickettsia, Coxiella, Chlamydia, Mycoplasma: general features, medical significance • Actinomycetes: General features of Nocardia and Streptomyces Importance • Archaea: Introduction- Major Archaeal physiological groups, Archaeal cell wall, lipids and membranes, Ecological importance • Protozoa- Major Categories of Protozoa Based on motility, reproduction. Medically important Protozoa Life cycle of Entamoeba • Algae – Characteristics of algae: morphology, Pigments, reproduction Cultivation of algae. Major groups of Algae –an overview. Algae. Differences between Algae and Cyanobacteria • Fungi and Yeast- Characteristics: structure, Reproduction. Major fungal divisions- overview. • Slime molds and Myxomycetes		**15**
Unit II Microbial interactions	• **Types of Microbial Interactions**: Mutualism, Cooperation, Commensalism, Predation Parasitism, Amensalism, Competition • **Microbial associations with vascular plants:**Phyllosphere, Rhizosphere & Rhizoplan;Plant pathogens • **Applications** o Biofertilizers: Mycorrhizae, Nitrogen fixation: Rhizobia, Stemnodulating Rhizobia Actinorhizae o Biopesticides :*Bacillus thuringiensis* based, o PGPRs: Fungal & Bacterial endophytes • Two sides of a coin:*Agrobacterium tumefaciens*		**15**

Course Code 23BUMB2P1	Course Title Practical based on 23BUMB2T1 and 23BUMB2T2	Credits 2	No. of lectures in hrs.: 60
Practical 1	**Practicals Based on Unit I of BNBUSMB2T1**		
1	Qualitative estimation of Carbohydrates- Benedicts, Molisch's test.		**3**
2	Qualitative estimation of Proteins, amino acids- Biuret, Ninhydrin		**3**
3	Qualitative estimation of Nucleic acid detection by DPA and Orcinol		**3**
	Practicals Based on Unit II of BNBUSMB2T2		
4	Haemocytometer		**3**
5	Viable count: Spread plate and pour plate		**12**
6	Effect of pH and temperature on growth		**3**
7	Measurement of cell dimensions-Micrometry		**3**
8	Growth curve		**6**
Practical 2	**Practicals Based on Unit I of BNBUSMB2T2**		
1	Spot assay for demonstration of bacteriophage		**2**
2	Fungal wet mount		**2**
3	Cultivation of fungi and yeast		**6**
4	Permanent slides of algae,		**3**
	Practicals Based on Unit II of BNBUSMB2T2		
5	Wet mount of lichen		**2**
6	Isolation of *Rhizobium*		**3**
7	Enrichment and isolation of *Azotobacter*		**6**

Course Code 23BUMB2T5	Course Title Common diseases and their management	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Describe typical course of infection and factors influencing the same • Enlist types of antimicrobial agents and would be able to explain measures for prevention of drug resistance.			
Unit I: **Microbes as infectious agents**	• **Human host and Microbes: interaction** • **Course of infection** • **Factors affecting infection** • **Types of infections** • **Common infections, signs and symptoms, prevention and cure** o Respiratory tract infection: upper o Gastrointestinal tract infection o Urinary tract infections o Skin infections		**15**
Unit II: **Introduction to antimicrobial agents**	• Antimicrobial agents • Properties of Ideal Antimicrobial agents • Basic definitions • drug effects • Two examples of each : Antibacterial, Antiviral, Antifungal • Problem of drug resistance and its prevention		**15**

23BU2CC07	**Course Title** Co-Curricular courses (CC) / Community Engagement and Field projects (CEP)	**30**	**2**
23BU2CC01	NSS-Social science		
23BU2CC02	NCC-Defense science		
23BU2CC03	DLLE		
23BU2CC04	Sports- Physical Education		
23BU2CC05	Culture		
Students will select any one above mentioned course			

Course Code 23BUIK2T9	Course Title Indian Knowledge System-II	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Learn about Indian Diet & its Impact on Health • Understand the importance of Ayurveda & Ancient Indian Drugs in day – to -day life			
Unit I: **Indian Diet & its Impact on Health**	• Ayurvedic detox programs • Yogic & Ayurvedic Diets • A balanced diet, the six tastes &Vipaka		**15**
Unit II: **Ayurveda & Ancient Indian Drugs**	**Ayurvedic Herbs:** Amla, Ginger, Ritha, Maka, Behada, Bell, Tondali, Brahmi, Anar, Corriander seeds, Durva, Erand, Papita, Gulvel, Haldi, Hirada, Hing, Jamun, Hibiscus, nutmeg, Cumin seeds, Banana,Karanja, Karela, Karpur, Khajur, Khaskhas, Kulith, Aloevera, Kesar, Lajalu, Lasun, Laung, Pepper, Methi, Saunf, Mula, Pan, coconut, Kadunimb, Onion, Fig, Sadafuli, Rai, Shatavari, Kadipatta, Shivga, Eliachi, Chandan, Chakraful, teel, Tulasi, Dalchini, Tamalpatra, Almond, Yashtimadhu, Ajwain, Ghee, Honey **The Five Main Methods of Herbal Preparation**		**15**

References: Semester I

Books and References: 23BUMB1T1					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood & Woolverton	McGraw-Hill	7th	2008
2.	Microbiology	Michael J Pelczar Jr. E. C. S Chan Noel R. Krieg	Tata McGraw-Hill	5th	1993
3	Microbiology: An Evolving Science	Slonczewski and Foster	Norton & Company, Inc.	4th	2016

Books and References: 23BUMB1T2					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood & Woolverton	McGraw-Hill	7th	2008
2.	Microbiology	Michael J Pelczar Jr. E. C. S Chan Noel R. Krieg	Tata McGraw-Hill	5th	1993
3.	Fundamentals of Microbiology	Martin Frobisher Ronald Hinsdill Koby Crabtree Clyde GoodHeart	Thomson Learning	6th	1957
4.	Fundamental Principles of Bacteriology	A J Salle	McGraw-Hill	2nd	1943
5.	General Microbiology	Stanier, Ingraham, Wheelis& Painter	McMillan Press Ltd.	5th	1987
6.	Microbiology: An Evolving Science	Slonczewski and Foster	Norton & Company, Inc.	4th	2016
7.	https://www.foldscope.com				

Books and References:23BUMB1T5					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood & Woolverton	McGraw-Hill	7th	2008
2.	Microbiology	Michael J Pelczar Jr. E. C. S Chan Noel R. Krieg	Tata McGraw-Hill	5th	1993
3.	Fundamentals of Microbiology	Martin Frobisher Ronald Hinsdill Koby Crabtree Clyde GoodHeart	Thomson Learning	6th	1957
4.	General Microbiology	Stanier, Ingraham, Wheelis& Painter	McMillan Press Ltd.	5th	1987
5.	Microbiology: An Evolving Science	Slonczewski and Foster	Norton & Company, Inc.	4th	2016

Books and References: 23BUMB1T7					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Code of Safety in Microbiological Laboratories	Bureau of Indian Standard	Published under the auspices of the Right to Information Act 2005	-	1987
2.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood & Woolverton	McGraw-Hill	7th	2008
3.	Microbiology: An Evolving Science	Slonczewski and Foster	Norton & Company, Inc.	4th	2016

Books and References:23BUIK1T2					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Yoga and Ayurveda: Self-Healing and Self-Realization	David Frawley	Motilal Banarsidass Publishing House	5th Reprint edition	2022
2.	Everyday Ayurveda – a practical guide to healthy living	Danny Cavanagh & Carol Willis	Ayurveda UK	1st	2004
3.	The Yoga of Herbs	Dr David Frawley & Dr Vasant Lad	Lotus Press	2nd	1993
4.	New Perspectives in Stress Management	H. R. Nagendra & Dr.R. Nagarathna	Swami Vivekananda Yoga Prakashana	3rd	1986

Semester II

Books and References: B23BUMB2T1					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood & Woolverton	McGraw-Hill	7th	2008
2.	Lehninger Principles of Biochemistry	D. Nelson & M. Cox	W H Freeman & Company	4th	2005
3.	Biochemistry	Satyanarayana and Chakrapani	Books & Allied (P) Ltd	4th	2017
4.	Microbiology: An Evolving Science	Slonczewski and Foster	Norton & Company, Inc.	4th	2016
5.	General Microbiology	Stanier, Ingraham, Wheelis & Painter	McMillan Press Ltd.	5th	1987

Books and References: 23BUMB2T2					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood & Woolverton	McGraw-Hill	7th	2008
2.	Microbiology	Michael J Pelczar Jr. E. C. S Chan Noel R. Krieg	Tata McGraw-Hill	5th	1993
3.	General Microbiology	Stanier, Ingraham, Wheelis& Painter	McMillan Press Ltd.	5th	1987
4.	Brock Biology of Microorganisms	Madigan, Martinko, Stahl & Clark	Benjamin Cummings	13th	2012
5.	Microbiology: An Evolving Science	Slonczewski and Foster	Norton & Company, Inc.	4th	2016
6	Foundations in Microbiology	Kathleen Park Talaro& Arthur Talaro	McGraw Hill	4th	2002
7.	Microbiology: An Introduction	Tortora, Funke and Case	Adisson Wesley Longman Inc	10th	2010

Books and References: 23BUMB2T5					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Prescott, Harley & Klein's Microbiology	Willey, Sherwood &Woolverton	McGraw-Hill	7th	2008
2.	Brock Biology of Microorganisms	Madigan, Martinko, Stahl & Clark	Benjamin Cummings	13th	2012
3.	Microbiology: An Evolving Science	Slonczewski and Foster	Norton & Company, Inc.	4th	2016
4.	Foundations in Microbiology	Kathleen Park Talaro& Arthur Talaro	McGraw Hill	4th	2002
5.	Microbiology: An Introduction	Tortora, Funke and Case	Adisson Wesley Longman Inc	10th	2010
6.	Textbook of Microbiology	R. Ananthanarayan and J. Paniker's	Universities Press	10th	2017

Books and References:23BUIK2T2					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Yoga and Ayurveda: Self-Healing and Self-Realization	David Frawley	Motilal Banarsidass Publishing House	5th Reprint edition	2022
2.	Everyday Ayurveda – a practical guide to healthy living	Danny Cavanagh & Carol Willis	Ayurveda UK	1st	2004
3.	The Yoga of Herbs	Dr David Frawley & Dr Vasant Lad	Lotus Press	2nd	1993

Credit Framework, Courses Framework and Evaluation Assessment Pattern under NEP

Level	Sem.	Faculty-DSC		Any Faculty		Vocational & Skill Enhancement Courses (VSC), SEC (VSEC)	Ability Enhancement Courses (AEC)/ Value Education Courses/ Indian Knowledge System (IKS)			Field Project/ Apprenticeship/ Community Engagement & Services	Credit	Cumulative Credits
		Subject	Subject	Subject			Subject					
		Major	Minor	GE & OE			AEC	VEC	IKS			
		CREDITS	CREDITS	CREDITS	CREDITS		CREDITS	CREDITS	CREDITS			
				GE	ID							
4.5	I.	06	06	02	02	02	02	-	02	-	22	44
	II.	06	06	02	02	-	02	-	02	02	22	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF courses/ internship or continue with Major and Minor												
Transforming F.Y.B.Sc. curriculum into NEP 2020 structure provided by the Government of Maharashtra												
Cum cr.		6*2 = 12	6*2 = 12	4*2 = 08		02	4*2 = 08			02	44	44

Level	Sem.	Faculty - DSC						Any Faculty		Vocational & Skill Enhancement Courses (VSC)	Ability Enhancement Courses (AEC)/Indian Knowledge System (IKS)		Field Project/ Apprenticeship/ Community Engagement & Services		Credit	Cumulative Credits
		Subject			Subject			Subject								
		Major - credits 6 (4T+2P)			Minor- credits 6 (4T+2P)			GE & OE								
		Course - I	Course -II	Course-III	Course- I	Course-II	Course-III	Course-I	Course-II		AEC	VEC	IKS			
Level4.5	I.	02 (2T)	02 (2T)	02 (2P)	02 (2T)	02 (2T)	02 (2P)	02 (2T)	02 (2T)	02 (1T+1P)	02 (2T)	-	02 (2T)	-	22	44
	II.	02 (2T)	02 (2T)	02 (2P)	02 (2T)	02 (2T)	02 (2P)	0 2 (2T)	02 (2T)	-	02 (2T)	-	02 (2T)	0 2	22	

Note: Students will get a choice of **VSC, SEC VSEC for credits- 2**

Credit Framework, Courses Framework and Evaluation Assessment Pattern under NEP

Level	Faculty – DSC	Theory					Practical		
		Internal	Min. Marks for passing	Theory Examination	Min. Marks for passing	Total	Practical Examination	Min. Marks for passing	Total
Sem I	**1. Major (Credits 06)**								
	Course – I	20	08	30	12	50	50	20	150
	Course – II	20	08	30	12	50			
	2. Minor (Credits 06)								
	Course – I	20	08	30	12	50	50	20	150
	Course – II	20	08	30	12	50			
	3. GE/ OE (Credits 04)								
	GE	20	08	30	12	50	-	-	100
	OE/CS	20	08	30	12	50			
	4. Vocational & Skill Enhancement Courses (VSC) (Credits 02)	-	-	25	10	25	25	10	50
	5. Ability Enhancement Courses (AEC)/ Value Education Courses/ Indian Knowledge System (IKS)								
	IKS (Credits 02)	20	08	30	12	50	-	-	50
	AEC (Credits 02) Sem I	20	08	30	12	50	-	-	50 Sem I
	6. Field Project/ Apprenticeship/ Community Engagement & Services (Credits 02) Sem II								
		20	08	30	12	50	-	-	50 Sem II
	SEM I TOTAL					425	125		550
	SEM I TOTAL					425	125		550
	FYBSC/ Certificate Total Marks								1100