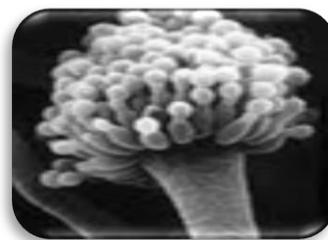
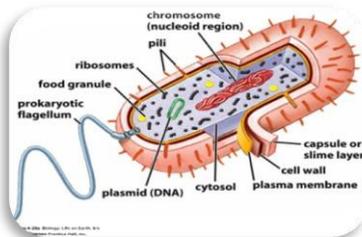


SAURASHTRA UNIVERSITY
Accredited at "A" Level by NAAC (CGPA 3.05)



COURSE STRUCTURE & SYLLABUS
FOR
UNDERGRADUATE PROGRAMME
IN

MICROBIOLOGY



(CORE COURSE FOR SEMESTER III & IV)
(As per Choice Based Credit System as recommended by UGC)

Effective from June – 2017
SAURASHTRA UNIVERSITY, RAJKOT



PREFACE

Updating and revision of the Curriculum at regular interval of time is a prime criterion of IQAC – NAAC and prime need for the college educational systems affiliated to Universities. University Grants Commission has advocated the implementation of Choice Based Credit System in undergraduate and post graduate levels for better teaching learning process and evaluation of the candidate.

Microbiology is a foundation subject for Biotechnology, Genetic engineering, Molecular biology, Biochemistry, Bioinformatics and Medical Microbiology and hence holds the central position in the curriculum of these subjects. Looking to the rapid inventions and technological developments in the field of Microbiology as well as keeping in view the recommendations of UGC and Saurashtra University, this syllabus has been formulated by the combined and coordinated efforts of all the faculty members of all the Microbiology Departments of Colleges affiliated to Saurashtra University.

Composition of Curriculum for a particular subject requires following criteria to be considered:

1. Guidelines and Model curriculum given by the UGC and the University
2. Regional needs and Present National and International trends in the subject
3. Geographical parameters of the University and its demographic property
4. Relationship with other related subjects
5. Financial and statutory provisions of the State government
6. Resources of Educational needs.

The content of a syllabus should be such that it maintains continuity with the course content of higher secondary class and post graduate course. The present curriculum is made keeping this in mind and is an effort to impart fundamental knowledge of the subject needed at this level. The curriculum is designed as per the guidelines for Choice Based Credit System and reflects the total credit, teaching hours and question paper style of the paper. The units of the syllabus are well defined and the scope of each is given in detail. A list of reference books is provided at the end of each course. Microbiology being an experimental science, sufficient emphasis is given in the syllabus for training in laboratory skills and instrumentation. Following objectives have been considered while formulation of the curriculum:

1. To provide an updated, feasible and modern syllabus to the students and thereby to build up their valuable college educational and job-oriented carrier.
2. To frame syllabus in accordance with the semester system and CBCS system.
3. Establishment of 10 Paper statuses up to Graduate level in the Saurashtra University

The authorities of Saurashtra University and the Dean of Science Faculty provided valuable guidelines and facilities for the same for which, the Board of Studies for Microbiology expresses its heartfelt gratitude. The Board wishes all the students pursuing Microbiology a very bright future.



(Dr. Mehul P. Dave)
Chairman, Board of Studies, Microbiology
Saurashtra University, Rajkot (Gujarat)
Date : 25th December 2016



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COURSE STRUCTURE FOR UG PROGRAM AND CREDIT SYSTEM

SKELETON OF COMPLETE COURSE CONTENT OF UNDER GRADUATE MICROBIOLOGY (SEMESTER I TO VI)

SEMESTER	PAPER NO. & CODE	TITLE OF THE PAPER	CREDIT
I	MB-101 (Theory)	Basic Aspects of Microbiology	4
	MB-101 (Practical)	-do-	3
II	MB-201 (Theory)	Microbial Chemistry and Microbial Control	4
	MB-201 (Practical)	-do-	3
III	MB-301 (Theory)	Microbial Systematics and Environmental Microbiology	4
	MB-301 (Practical)	-do-	3
IV	MB-401 (Theory)	Applied Microbiology	4
	MB-401 (Practical)	-do-	3
V	MB-501 (Theory)	Immunology and Medical Microbiology	4
	MB-501 (Practical)	-do-	3
	MB-502 (Theory)	Prokaryotic Metabolism	4
	MB-502 (Practical)	-do-	3
	MB-503 (Theory)	Molecular Biology and Genetic Engineering	4
	MB-503 (Practical)	-do-	3
VI	MB-601 (Theory)	Bioprocess Technology	4
	MB-601 (Practical)	-do-	3
	MB-602 (Theory)	Analytical Techniques and Bioinformatics	4
	MB-602 (Practical)	-do-	3
	MB-603 (Theory)	Clinical and Diagnostic Microbiology	4
	MB-603 (Practical)	-do-	3

SYLLABUS FORMAT OF SEMESTER 3 AND SEMESTER 4

Stream	Paper	Unit	Title of Unit	Credit	Lectures	Marks		
						External	Internal	
B.Sc. Sem-3 (UG) Paper- 301	MB-301- MICROBIAL SYSTEMATICS AND ENVIRONMENTAL MICROBIOLOGY THEORY CREDIT (04)	1	INTRODUCTION TO MICROBIAL DIVERSITY	0.8	12	70	14	30
		2	PROKARYOTIC DIVERSITY	0.8	12		14	
		3	EUKARYOTIC DIVERSITY	0.8	12		14	
		4	AKARYOTIC DIVERSITY(VIRUSES)	0.8	12		14	
		5	ENVIRONMENTAL MICROBIOLOGY	0.8	12		14	
	Total				04	60	100	
	MB301 PRACTICAL CREDIT (03)	CULTIVATION, ISOLATION AND IDENTIFICATION OF SELECTED SEPECIES OF PROKARYOTES AND EUKARYOTES. WATER ANALYSIS AND AIR FLORA DETERMINATION		03	30	35	15	
Total				03	30	50		
B.Sc. Sem-4 (UG) Paper- 401	MB- 401 APPLIED MICROBIOLOGY THEORY CREDIT (04)	1	SOIL AND AGRICULTURAL MICROBIOLOGY	0.8	12	70	14	30
		2	FOOD MICROBIOLOGY	0.8	12		14	
		3	DAIRY MICROBIOLOGY	0.8	12		14	
		4	MICROBIOLOGY OF DRINKING WATER AND WASTE WATER	0.8	12		14	
		5	PHARMACEUTICAL MICROBIOLOGY	0.8	12		14	
	Total				04	60	100	
	MB401 PRACTICAL CREDIT (03)	ISOLATION OF NIROGEN FIXING BACTERIA, XANTHOMONAS, MICROBIAL ANALYSIS OF MILK AND WATER SAMPLES, PHARMACEUTICAL TESTING		03	30	35	15	
Total				03	30	50		

GENERAL INSTRUCTIONS

- 1) The Medium of Instruction will be English for Theory and practical course
- 2) There will be 6 Lectures / Week / Theory Paper / Semester.
- 3) Each Lecture (Period) will be of 55 Mins. (1 Period = 55 Mins).
- 4) There will be 2 Practical / Week / Paper / Batch. Each Practical will be of 3 Periods (1 Period 55 Mins.).
- 5) Each Semester Theory Paper will be of FIVE Units. There will be 60 Hrs. of Theory teaching / Paper / Semester.
- 6) Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks. So, Total Marks of Theory and Practical for each Paper will be 150. (100+50 = 150)

Instructions to the Candidates for Practical Examination:

- 1) The practical examination will be conducted for TWO (2) days.
- 2) The Time duration of practical examination will be of FOUR (4) hrs on both the days.
- 3) All the students have to remain present at the examination centre 15 minutes before the scheduled time for examination.
- 4) Students have to carry with them Certified journal, I-card or examination receipt, Slide box, Apron and all other necessary requirements for examination.
- 5) Candidate should not leave the laboratory without the permission of examiner.
- 6) Use of calculator is allowed but the use of Mobile phones is strictly prohibited.
- 7) The candidate has to leave the laboratory only after the submission of all the answer sheets of the exercises performed.

SKELETON OF THEORY EXAMINATION (EXTERNAL)

QUESTION 1 – UNIT 1		
Q 1 A	Objective type questions	4 Marks
Q 1 B	Answer in brief (Any 1 out of 2)	2 Marks
Q 1 C	Answer in detail (Any 1 out of 2)	3 Marks
Q 1 D	Write a note on (Any 1 out of 2)	5 Marks
QUESTION 2 – UNIT 2		
Q 2 A	Objective type questions	4 Marks
Q 2 B	Answer in brief (Any 1 out of 2)	2 Marks
Q 2 C	Answer in detail (Any 1 out of 2)	3 Marks
Q 2 D	Write a note on (Any 1 out of 2)	5 Marks
QUESTION 3– UNIT 3		
Q 3 A	Objective type questions	4 Marks
Q 3 B	Answer in brief (Any 1 out of 2)	2 Marks
Q 3 C	Answer in detail (Any 1 out of 2)	3 Marks
Q 3 D	Write a note on (Any 1 out of 2)	5 Marks
QUESTION 4 – UNIT 4		
Q 4 A	Objective type questions	4 Marks
Q 4 B	Answer in brief(Any 1 out of 2)	2 Marks
Q 4 C	Answer in detail (Any 1 out of 2)	3 Marks
Q 4 D	Write a note on (Any 1 out of 2)	5 Marks
QUESTION 5 – UNIT 5		
Q 5 A	Objective type questions	4 Marks
Q 5 B	Answer in brief (Any 1 out of 2)	2 Marks
Q 5 C	Answer in detail (Any 1 out of 2)	3 Marks
Q 5 D	Write a note on (Any 1 out of 2)	5 Marks
TOTAL MARKS : 70 TOTAL TIME : 2½ HOURS		

SKELETON OF PRACTICAL EXAMINATION (EXTERNAL)

SEMESTER – III and IV : MB 301 and MB 401

**SECTION- I: EXAMINER – I
(EXTERNAL)**

Ex. No.	Detail of Exercise	Marks	Day to begin the exercise
1	Perform any one from the given list of exercises as per the instruction of the examiner exercise	10	1 st Day
5	Viva-voce	04	1 st / 2 nd Day
6	Certified Journal	03	1 st / 2 nd Day
Total Marks		17	

**SECTION- II: EXAMINER –II
(INTERNAL)**

Ex. No.	Detail of Exercise	Marks	Day to begin the exercise
2	Perform any one from the given list of exercises as per the instruction of the examiner exercise	10	1 st / 2 nd Day
3	Spotting	04	1 st / 2 nd Day
4	Viva-voce	04	1 st / 2 nd Day
Total Marks		18	

INTERNAL EVALUATION FOR MB 301 AND MB 401 (THEORY)

No.	Pattern of Internal Evaluation	Marks
1	Assignment	10
	MCQ Test	10
	Seminar/Presentation	10
OR		
2	MCQ Test	30
OR		
3	Assignment	10
	MCQ Test	20
OR		
4	Seminar/Presentation	10
	MCQ Test	20

INTERNAL EVALUATION FOR MB 301 AND MB 401 (PRACTICAL)

No.	Pattern of Internal Evaluation	Marks
1	Reagent Preparation/Calculation	05
2	Practical Performance/Test	05
3	Viva	05

LIST OF INSTRUMENTS FOR MICROBIOLOGY SEMESTER 3 AND 4

No.	Name of Instrument
1	Compound Microscopes
2	Autoclave
3	Incubator
4	Hot air oven
5	Vortex mixer
6	Water bath
7	Heating mantle
8	Magnetic stirrer
9	UV chamber
10	Inoculation chamber
11	pH meter
12	Colony counter
13	Refrigerator
14	Bunsen burner
15	Micrometer (stage and ocular)
16	Colorimeter
17	Membrane filter set
18	Centrifuge
19	Electronic shaker Incubator
20	Electronic Analytical Balance
21	Double-pan Analytical Balance
22	Spectrophotometer
23	Computers with internet connection
24	Water distillation system
25	Haemocytometers
26	Inspissator
27	Vertical and Circular Chromatography chambers
28	PAGE apparatus
29	Agarose Gel Electrophoresis apparatus
30	LCD Projector set up

SYLLABUS FOR MICROBIOLOGY SEMESTER - III

(With effect from June 2017)

MB-301- MICROBIAL SYSTEMATICS AND ENVIRONMENTAL MICROBIOLOGY (THEORY)

UNIT 1 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

INTRODUCTION TO MICROBIAL DIVERSITY

- 1.1 Introduction to Biodiversity- Microbial evolution and diversity
- 1.2 Microbial Taxonomy: Introduction and overview
- 1.3 Classification systems - Taxonomic ranks of microorganisms
- 1.4 Major characteristics used in taxonomy
- 1.5 Phylogeny- Survey of Prokaryotic Phylogeny and Phylogenetic Groups of Eukaryotes
- 1.6 Introduction to metagenomics

REFERENCE BOOKS (SEMESTER 3 UNIT 1)

1	Prescott, Healey and Klein., <u>Microbiology-5th International Edition</u> , Tata-McGraw Hill publications, Delhi
2	Atlas. R.M., <u>Principles of Microbiology- 2nd Edition</u>
3	Modi, H.A. <u>Elementary Microbiology - Vol -I</u> , Akta Prakashan, Nadiyad

UNIT 2 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

PROKARYOTIC DIVERSITY

- 2.1 Introduction to Archaea and Eubacteria
- 2.2 Gram negative bacteria – General features of:
Aerobic/Microaerophilic motile, helical vibroid
Non-motile curved bacteria
Aerobic/Microaerophilic rods and cocci
Facultative anaerobes – rods, curved and helical bacteria
Dissimilatory Sulfate reducers
Anaerobic cocci
Phototrophic bacteria
- 2.3 Gram positive bacteria – General features of:
Endospore forming rods and cocci
Asporogenous rods
Mycobacteria and Actinomycetes
- 2.4 Extremophilic Microorganisms

REFERENCE BOOKS (SEMESTER 3 UNIT 2)

1	Prescott, Healey and Klein., <u>Microbiology-5th International Edition</u> , Tata-McGraw Hill publications, Delhi
2	Atlas. R.M., <u>Principles of Microbiology- 2nd Edition</u>
3	Modi, H.A. <u>Elementary Microbiology - Vol -I</u> , Akta Prakashan, Nadiyad
4	Pelczar, M.J., Chan E.C.S., Krieg, N.R., <u>Microbiology, 5 Edition</u> . Tata McGraw Hill Publication Co. Ltd. New Delhi.
5	Tortora, Funke & Case. <u>Microbiology-An Introduction, 8 Edition</u> , Pearson Education, Delhi.
6	Stainer, R.Y., Ingraham, J.L., Wheelis, M.L., Painter, R.K. <u>General Microbiology, 5th Edition</u> . MacMillan Press Ltd., London.
7	Salle, S.J. <u>Fundamental Principals of Bacteriology</u> , Tata McGraw Hill Publication Co. Ltd. New Delhi.
8	Frobisher M., Hinsdill, Crabtree and Goodherat, <u>Fundamentals of Microbiology, 9th Edition</u> . W.B Saunders Co. USA .

UNIT 3 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

EUKARYOTIC DIVERSITY

A: FUNGI:

3.1 General characteristics – Definition, occurrence, Structure , Reproduction

3.2 Classification and introduction to major divisions of Fungi

3.3 Economic importance of fungi

B: ALGAE:

3.4 General Characteristics – Definition, Occurrence, Ultra- Structure, Reproduction

3.5 Economic importance of Algae

C: PROTOZOA:

3.6 General Characteristics – Definition, Occurrence, Ultra- Structure, Reproduction

3.7 Economic importance of Protozoa

REFERENCE BOOKS (SEMESTER 3 UNIT 3)

1	Prescott, Healey and Klein., <u>Microbiology-5th International Edition</u> , Tata-McGraw Hill publications, Delhi
2	Atlas. R.M., <u>Principles of Microbiology- 2nd Edition</u>
3	Modi, H.A. <u>Elementary Microbiology - Vol -I</u> , Akta Prakashan, Nadiyad
4	Pelczar, M.J., Chan E.C.S., Krieg, N.R., <u>Microbiology, 5 Edition</u> . Tata McGraw Hill Publication Co. Ltd. New Delhi.
5	Dubey, R.C.and Maheshwari, D.K., <u>A Text Book of Microbiology</u> , S. Chand Publications , New Delhi.
6	Powar and Dagainawala, <u>General Microbiology Vol-II</u> . Himalaya Publishing House, Mumbai.

UNIT 4 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

AKARYOTIC DIVERSITY(VIRUSES)

- 5.1 Introduction and General Characteristics:
Definition, Structure, Classification
- 5.2 Cultivation and Enumeration of Viruses
- 5.3 Bacterial Viruses:
Classification, Lytic life cycle (T4 phage), lysogenic life cycle (Lambda phage)
- 5.4 Introduction to Animal Viruses:
Classification, Replication, Cytocidal effects, Viruses and Cancer, Prions
- 5.5 Introduction to Plant Viruses:
Classification, Structure & Replication of TMV, Economic importance, Viroids

REFERENCE BOOKS (SEMESTER 3 UNIT 4)

1	Prescott, Healey and Klein., <u>Microbiology-5th International Edition</u> , Tata-McGraw Hill publications, Delhi
2	Atlas. R.M., <u>Principles of Microbiology- 2nd Edition</u>
3	Mani, A., Selwaraj, A.M., Narayanan L.M., and Arumngam, N., <u>Microbiology</u> , Saras Publication, Delhi
4	Pelczar, M.J., Chan E.C.S., Krieg, N.R., <u>Microbiology, 5 Edition</u> . Tata McGraw Hill Publication Co. Ltd. New Delhi.
5	Harmeet Kaur, <u>Encyclopedia of Microbiology</u> , Anmol Publication, Delhi

UNIT 5 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

ENVIRONMENTAL MICROBIOLOGY

- 5.1 Biodegradation and bioremediation
- 5.2 Biomagnification of pesticides
- 5.3 Biodeterioration of Paper, Textiles, paints, woods & metals and its control
- 5.4 Microbial Air Pollution & Air Sanitation
- 5.5 Bioleaching of metals and Microbial enhanced oil recovery
- 5.6 Biofuels
- 5.7 Bioplastics

REFERENCE BOOKS (SEMESTER 3 UNIT 5)

1	<u>Environmental microbiology</u> by Rania Maier, Academic Press
2	Atlas. R.M., <u>Principles of Microbiology- 2nd Edition</u>
3	<u>Biotechnology</u> by Smith, Oxford University Press
4	Pelczar, M.J., Chan E.C.S., Krieg, N.R., <u>Microbiology, 5 Edition</u> . Tata McGraw Hill Publication Co. Ltd. New Delhi.
5	<u>Biotechnology fundamental & applications</u> By Purohit S.S.

MB-301- MICROBIAL SYSTEMATICS AND ENVIRONMENTAL MICROBIOLOGY (PRACTICAL)

**Practical Hours – 3hrs/day for 2 days/Week
= Total 6 hours/Week**

Total Credit – 3

- 1. Isolation of Gram negative bacteria from the given sample.**
- 2. Identification of Gram negative bacteria from the given pure culture using biochemical media (*E.coli, Entrobacter aerogens, Proteus, Salmonella*)**
- 3. Isolation of Gram positive bacteria from the given sample.**
- 4. Identification of Gram positive bacteria from the given pure culture using biochemical media (*Bacillus megaterium, Bacillus subtilis, staphylococcus aureus, Streptococcus*)**
- 5. Identification of Fungi on the basis of Morphological Characteristics.**
- 6. Cultivation of yeast from different natural samples and its morphological characterization using microscopic observation.**
- 7. Microscopic observation of different algae from the given samples.**
- 8. Microscopic observation of different protozoa from the given sample.**
- 9. Isolation and cultivation of bacteriophage of *E.coli* from the given sewage sample.**
- 10. Chemical analysis of water: Chloride, Hardness, Nitrite Nitrogen, Alkalinity, Acidity, TDS, TSS, TS**
- 11. Determination of air flora and air density from indoor & outdoor sources**
- 12. Field Visit to Sewage treatment plant / Forest / Sanctuary / Soil Research Laboratory / GPCB Station and preparation of report**

REFERENCE BOOKS (SEMESTER 3 PRACTICAL)

- 1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.**
- 2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.**
- 3. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi**
- 4. Konika Sharma., manual of Microbiology – Tools & Techniques, Ane Books, Delhi.**

SAURASHTRA UNIVERSITY, RAJKOT
SYLLABUS FOR MICROBIOLOGY SEMESTER - IV
(With effect from June 2017)

MB-401 : APPLIED MICROBIOLOGY
(THEORY)

UNIT 1 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

SOIL AND AGRICULTURAL MICROBIOLOGY

A Soil Microbiology

- 1.1 Physical & Chemical Characteristics of Soil
- 1.2 Rhizosphere & Microbial flora of Soil
- 1.3 Interactions among soil microorganisms: Neutral, Beneficial & Harmful interactions
- 1.4 Introduction to sedimentary and gaseous biogeochemical cycles and role of microorganisms
- 1.5 Nitrogen fixation and Winogradsky's column

B Agricultural Microbiology

- 1.5 Pathogens for plant diseases : Plant mycology, Plant bacteriology and Plant virology
- 1.6 Management of plant disease
- 1.7 Biofertilizers
- 1.8 Biopesticide and biocontrol

Reference books:

1	Principles of Microbiology By Atlas R.M.: 2 nd edition
2	Microbiology by Pelczar M.J. & Chain E.C.S. : 5 th edition
3	Introduction to soil microbiology by Alexander M: 2 nd edition
4	Biotechnology fundamental & applications By Purohit S.S.
5	Diseases of Crop plants in India by Rangaswami G.
6	Microbiology fundamental & applications By Purohit S.S.

UNIT 2 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

FOOD MICROBIOLOGY

- 2.1 Microbial flora of fresh food
- 2.2 Microbial spoilage of foods: Fresh foods & Canned foods
- 2.3 Food Borne infection & intoxication: Role of *S.aureus*, *C.botulinum* & *Salmonella* Spp.in food poisoning
- 2.4 Preservation of foods: General principles & methods of food preservation
- 2.5 Microbiological examination of food; Introduction to AGMark
- 2.6 Brief introduction about fermented foods: Pickles, Sauerkraut, Silage, Sausages & Bread
- 2.7 Microorganisms as food: Single Cell Protein, Mushrooms and Functional foods

Reference books:

1	Fundamentals of Microbiology By Frobisher M.: 9 th edition
2	Microbiology by Pelczar M.J. & Chain E.C.S. : 5 th edition
3	Industrial Microbiology by Prescott S.C. : 3 rd edition
4	Food Microbiology by Frazier W.C. : 3 rd edition
5	Food science & Experimental foods By Swaminathan M.
6	Modern food microbiology by J James

UNIT 3 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

DAIRY MICROBIOLOGY

- 3.1 Milk as a medium, normal flora of milk
- 3.2 Types of microorganisms in milk: Biochemical types, Pathogenic types, Temperature types
- 3.3 Spoilage of milk & milk products
- 3.4 Microbial analysis of milk: SPC, Direct count, MBRT, Resazurin test
- 3.5 Grading of milk
- 3.6 Fermented milk Beverages & Manufactured Dairy Products: Starter Culture, Cheese, Yogurt, Buttermilk, Acidophilus milk, Kefir
- 3.7 Preservation of milk: Principles & methods of preservation

Reference books

1	Fundamentals of Microbiology By Frobisher M.: 9 th edition
2	Microbiology by Pelczar M.J. & Chain E.C.S. : 5 th edition
3	Industrial Microbiology by Prescott S.C. : 3 rd edition
4	Food Microbiology by Frazier W.C. : 3 rd edition
5	Fundamentals of Dairy Microbiology by Prajapati J.B.

UNIT 4 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

MICROBIOLOGY OF DRINKING WATER AND WASTE WATER

A Microbiology of drinking water

- 4.1 Sanitary survey, Bacteriological evidence of pollution, Bacteriological analysis & Sampling techniques of water
- 4.2 Microorganisms other than Coliforms as nuisance organisms

B Water purification

- 4.3 Sedimentation, Filtration use of Sand filters, Disinfection

C Waste water

- 4.4 Chemical and Microbial Characteristics of waste water, B.O.D., C.O.D. as indicator of quality of waste water
- 4.5 Waste water treatment & Disposal - Single Dwelling Process & Municipal

Treatment - Primary Treatment, Secondary Treatment, Advanced & final treatment

4.6 Solid waste processing: Anaerobic Sludge digestion & Composting

Reference books

1	Principles of Microbiology By Atlas R.M.: 2 nd edition
2	Microbiology by Pelczar M.J. & Chain E.C.S. : 5 th edition
3	Environmental microbiology by Rania Maier, Academic Press
4	Advanced Waste water Treatment by R.K. Goel
5	Microbiology fundamental & applications By Purohit S.S.
6	Microbiology by Prescott L.M.

UNIT 5 (CREDIT-0.8, TEACHING HOURS-12, MARKS-14)

PHARMACEUTICAL MICROBIOLOGY

- 5.1 Introduction to pharmaceutical microbiology and pharmacopoeia
- 5.2 Sterility testing of pharmaceutical products
- 5.3 Quality assurance and validation : GMP and GLP in pharmaceutical industries
- 5.4 Quality assurance and quality management in pharmaceuticals : ISO, WHO and other certifications
- 5.5 Total Quality Management

Reference books

1	Pharmaceutical Microbiology by Ashutosh Kar, New Age International Publishers
2	Pharmaceutical Microbiology – Edt. by W.B.Hugo & A.D.Russell Sixth edition. Blackwell scientific Publications.
3	Quality control in the Pharmaceutical Industry - Edt. by Murray S.Cooper Vol.2. Academic Press New York.

MB-401- APPLIED MICROBIOLOGY (PRACTICAL)

**Practical Hours – 3hrs/day for 2 days/Week
= Total 6 hours/Week**

Total Credit – 3

1. Isolation of nitrogen fixing bacteria
2. Cultivation of nitrifying and denitrifying bacteria (Demo)
3. Cultivation of cellulose decomposing microorganisms from soil(Demo)
4. Demonstration of oozing , and isolation of pathogen from diseased specimen of lemon leaf showing citrus canker and isolation of *Xanthomonas spp.*
5. Standard qualitative analysis of milk
6. Methylene Blue Reduction Time test for milk
7. Isolation and identification of coli forms from Water by Presumptive, Confirmed & Completed test
8. To determine MIC, LD 50 of Beta-lactum/aminoglycoside/ tetracycline/ansamycins (Demo)
9. Sterility testing by *Bacillus stearothermophilus*
10. Sampling of pharmaceuticals for microbial contamination and load (syrops, suspensions, creams and ointments, ophthalmic preparations).

REFERENCE BOOKS (SEMESTER 4 PRACTICAL)

1. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-I, Aditya Publications, Ahmedabad, India.
2. Patel. R.J., Patel. K.R., Experimental Microbiology, Vol-II, Aditya Publications, Ahmedabad, India.
3. Dubey. R.C., Maheshwari. D.K., Practical Microbiology, S.Chand & Company Ltd., New Delhi
4. Konika Sharma., manual of Microbiology – Tools & Techniques, Ane Books, Delhi.