



MAHARAJA KRISHNAKUMARSINHJI BHAVNAGAR UNIVERSITY

NAAC Accreditation Grade "B"
(With effect from Academic Year 2014-2015)

Academic Council: 23 / 11 / 2013, R.No. (2)

S.Y. B.Sc. Microbiology

The course content has been designed on Academic Annual Year pattern.

The work load for theory : There shall be **three lectures** per paper in a week set up by department.

The work load for Practical: There shall be **three Practicals** in a week set up by department.

There shall be **three theory papers** and **related practicals** in Academic Year end Examination.

The University Theory examination comprises of 3 **theory papers**.

Sr. No	PAPER No.	Name of The Paper	Total Marks	Passing Standard
1	MI-201 Theory	Introduction to Microbiology	75	27
2	MI-202 Theory	Biochemistry and Physiology of Microorganisms	75	27
3	MI-203 Theory	Applied and Environmental Microbiology	75	27
4	Practical	Microbiology Practical	75	27
	TOTAL		300	108



S.Y. B.Sc.
Microbiology

Paper No-MI-201: Introduction to Microbiology

Total Marks: 75

UNIT	DETAILED COURSE	TEACHING HOURS
Unit-1	<p>History and Scope of Microbiology History of Microbiology</p> <ol style="list-style-type: none"> Discovery of animalcules Spontaneous generation disputes Germ theory of Diseases Germ theory of fermentation Golden period of Microbiology <p>Scope of Microbiology</p> <ol style="list-style-type: none"> Pure & Applied areas of Microbiology. <p>Introduction to bacterial nomenclature and taxonomy.</p> <ol style="list-style-type: none"> Whittaker's five kingdom classification Major characteristics used in taxonomy. Approaches to classification <ul style="list-style-type: none"> ▪ Phenetic ▪ Numerical ▪ Phylogenetic ▪ Molecular tools : Tm, mol % G+C content, 16s RNA, Nucleic acid hybridization ▪ Present Picture Bergey's Manual of Systematic Bacteriology (2nd Edition) 	15
Unit-2	<p>Microbial study techniques Microscopes and Microscopies</p> <ol style="list-style-type: none"> Simple and Compound Light Microscope Bright Field Microscopy Dark field Microscopy Electron Microscope: TEM and SEM Phase contrast Microscopy Fluorescence Microscopy <p>Microbial study techniques</p> <ol style="list-style-type: none"> Smear preparation and fixation Wet mounting Micrometry <p>Dyes, Stains and staining.</p> <ol style="list-style-type: none"> Types and applications of stain. Principles of staining techniques. Application of simple, negative and differential stain. 	15
Unit-3	<p>The Morphology and fine structure of bacteria. The size, shape and arrangement of bacterial cells. Bacterial cell structures, composition and functions.</p> <p><u>EXTERNAL</u></p> <ol style="list-style-type: none"> Cell wall Pili. (Fimbriae) and Flagella 	15



	<p>c. Capsule and sheaths d. Prosthecae and stalk.</p> <p><u>INTERNAL</u></p> <p>a. Cytoplasmic membrane. b. Protoplasts – spheroplast and Mycoplasma c. Protoplasm, Protoplasmic inclusions and vacuoles d. Nuclear material.</p> <p>Sporulation (Endospore and cyst production) and germination of spores</p>	
Unit-4	<p>Introduction to acellular and Prokaryotic Bacteria</p> <p>a. Phototrophic bacteria b. Actinomycetes c. Rickettsiae and Chlamydia</p>	15
Unit-5	<p>Study of eukaryotic Microorganisms</p> <p>Fungi including yeasts.</p> <p>a. Characteristics, Reproduction and Cultivation. b. Outline of classification and importance of fungi and yeasts</p> <p>Algae.</p> <p>a. Occurrence and Characteristics b. Outline classification and importance of algae.</p> <p>Protozoa.</p> <p>a. Occurrence, Morphology and Outline of Classification b. Ecology of protozoa: Free living, Symbiotic.</p>	15

Reference Books:

1.	Microbiology (5 th Edition) Pub; McGraw Hill Book Company. N. Y.	- Pelczer M. J. Chan E.C.S. Krieg N.L.R.
2.	Microbiology (International Edition) Concepts and applications. Pub; McGraw Hill Book Company. N. Y. N. Secondar N.Y.	- Pelczer M. J. Chan E.C.S. Krieg N.R.
4.	General Microbiology (7 th Edition). Pub; Cambridge University Press (Low Price Edition.)	- Hans G. Schlegel
5.	Biology of microorganisms (Brocks') (9 th Edition) 2002 Prentice Hall, Intn Inc. N.Y.	- Madigan, M. T. Martinko & J. Parker.
6.	General Microbiology (5 th Edition) Pub; Macmillan Education Ltd., Hampshire.	- Stanier R. J., Ingraham J. L. Wheelio M. L., Painter P. R.
7.	Basic Microbiology With applications (2 nd Edition) Pub; Prentice Hall, New Jersey	- Brock K. M.
8.	Microbiology : An Introduction Pub: The Benjamin / gumming Publishing INC. London.12	- Tortora G. J., Funke B. R. Case C. L.
9.	Microbiology : Fundamentals and Applications Pub: Macmillan Publishing Co, New York	- Atlas R. M.
10.	Introduction Mycology (3 rd Edition) Pub: Willey Eastern Ltd. New Delhi	- Alexopoulos C. J.
11.	Elementary Microbiology Vol. I & II - Edited by Pub: Akta Prakashan, Nadiad, INDIA	- Modi H-A
12.	Microbes in action Pub: McGra Hill Books Co. pelazer,	- Seeley H. W. Vandemark P. J.
13.	Zinsser Microbiology (15 th Edition) Pub: Meredith Corpo Ration, N. Y.	- Joklik W. K. Smith D. T.



14.	The Blue Greens Pub: Edward Arnold, London.	- Fay Peter
15.	Microbiology : Concepts and Applications Pub: John Wiley and Sons, N. Y.	- P. A. Ketchum
16.	Basic Microbiology (5 th Edition) Wheeler M. F.	- Volk W. A.
17.	Microbiology (2 nd Edition) Pub: WCB McGraw	- Lim Dginel Hill, Boston
18.	Fundamental principles of bacteriology	- A. J. Salle
19.	Textbook of Microbiology	- R. Ananthanarayan C.K.Jayaeen Panikar
20.	Fundamental of Microbiology	- I. Edward Alcamo
21.	General Microbiology Vol. I & II. Pub: Himalaya Publishing House, Mumbai	- Dr. C. B. Powar Dr. H.F. Daginawala
22.	A text book of microbiology	- R C Dube D K Maheshwari



S.Y. B.Sc.

Microbiology

Paper No-MI-202: Biochemistry and Physiology of Microorganisms

Total Marks: 75

UNIT	DETAILED COURSE	TEACHING HOURS
Unit-1	Introduction to biochemistry General Properties, Structure, Types, Classification with suitable examples and Functions of important bio-molecules e. Carbohydrates f. Proteins g. Lipids h. DNA and RNA (Nucleic acids) Some functional bio-molecules: Definition, general properties, types and functions a. Antigen b. Antibody c. Vitamins d. Hormones e. Siderophores f. Bacterial chlorophyll	15
Unit-2	Enzymes and coenzymes a. General properties. b. Nomenclature and classification. c. Nature and mechanism of enzyme action. d. Factors affecting enzyme activity. e. Inhibition of enzyme action. f. Regulatory (allosteric) enzymes g. Applications of enzymes: • Research / Academic • Industrial • Diagnostic / Therapeutic h. Types and functions of coenzymes and co-factors.	15
Unit-3	Bioenergetics and Catabolism. Principles mode of energy production a. Photophosphorylation. b. Oxidative phosphorylation including substrate level and ETC Carbohydrate pathways and its regulation: a. EMP Pathway and pyruvic acid as a key compound b. HMP Pathway c. ED Pathway d. TCA Cycle	15
Unit-4	Nutrition, Cultivation, Isolation and Preservation of Microbial cultures Nutrition a. Requirements, Nutritional types and transport across cell membrane Cultivation a. Microbiology and Media: (Types, common ingredients, steps and preparation)	15



	<p>b. Cultivation of aerobic and anaerobic Microorganisms</p> <p>c. Physical conditions required for the cultivation of bacteria (temperature, gaseous requirements, acidity and alkalinity, hydrostatic pressure, etc.)</p> <p>d. Isolation and preservation of pure cultures [Various techniques, and their principle, applications, advantages and limitations]</p> <p>Culture collection centres and gene bank</p>	
Unit-5	<p>Microbial reproduction, growth and control</p> <p>Reproduction: Modes of cell division and new cell formation.</p> <p>Microbial growth</p> <p>a. Types of growth: continuous, synchronous, batch and random growth</p> <p>b. Normal growth curve of bacteria</p> <p>c. Factors affecting growth</p> <p>d. Techniques of measuring bacterial growth [Principle, method, advantages and limitations]</p> <p>Control of microorganisms in vitro</p> <p>a. Definition of terms</p> <p>b. Physical agents / agencies for control of microorganisms in vitro</p> <p>c. Chemical agents / agencies for control of microorganisms in vitro</p> <p>d. Ideal disinfectant</p> <p>e. Evaluation methods for antiseptics and disinfection e.g. Phenol coefficient</p>	15

Reference Books:

1.	Microbiology (5 th Edition) Pub; McGraw Hill Book Company. N. Y.	- Pelczer M. J., Chan E.C.S. Krieg N.L.R.
2.	Microbiology (International Edition) Concepts and Applications. Pub; McGraw Hill Book Company. N. Y. N. Secondar N.Y.	- Pelczer M. J., Chan E.C.S. Krieg N.R.
3.	General Microbiology (7 th Edition). Pub; Cambridge University Press (Low Price Edition.)	- Hans G. Schlegel
4.	Biology of microorganisms (Brocks') (9 th Edition) 2002 Prentice Hall, Intn Inc. N.Y.	- Madigan, M. T. Martinko & J. Parker.
5.	General Microbiology (5 th Edition) Pub; Macmillan Education Ltd., Hampshire.	- Stanier R. J., Ingraham J. L. Wheelio M. L, Painter P. R.
6.	Microbiology : Fundamentals and Applications Pub: Macmillan Publishing Co, New York	- Atlas R. M.
7.	Outlines of Biochemistry (5 th Edition) Pub: John Willey & Sons, N.Y.	- Conn E. B., Stumpf P. K. Bruening G., Doi R. H.
8.	Elementary Microbiology Vol. I & II - Edited by Pub: Akta Prakashan, Nadiad, INDIA	- Modi H-A
9.	Textbook of biochemistry Pub: Prentice-Hall of india Pvt. Ltd. New Delhi.	- Ranganatha Rao.
10.	General Biochemistry, Pub: Wiley Eastern Ltd. New Delhi.	- Weil J. H.
11.	Zinsser Microbiology (15 th Edition) Pub: Meredith Corpo Ration, N. Y.	- Joklik W. K. Smith D. T.
12.	Biochemistry of Bacterial Growth (2 nd Edition) Pub: Blackwell Scientific pub. Oxford, London	- Mandelstam J. Mcquilloen K.
13.	Review of Physiological chemistry (17 th Edition) Pub: Kothari Book Depot, Parel, Bombay - 430 066.	- Harper H. A., Rodwell V. H. Mayes P. A.



14.	Elementary Biochemistry (2 nd Edition) Pub: Vakils, ferror and Simons Pvt. Ltd. Bombay	- Merta E. T.
15.	Basic Microbiology (5 th Edition), Wheeler M. F.	- Volk W. A.
16.	Microbiology (2 nd Edition), Pub: WCB McGraw	- Lim Dginel, Hill, Boston
17.	A textbook of environmental chemistry and pollution control (3 rd Edition) Pub: S. Chand and Company Ltd., New Delhi - 110 055.	- S. S. Dara
18.	Textbook of Microbiology	- R. Ananthanarayan C.K.Jayaeen Panikar
19.	General Microbiology Vol. I & II. Pub: Himalaya Publishing House, Mumbai	- Dr. C. B. Powar Dr. H.F. Daginawala
20.	A text book of microbiology	-R C Dube, D K Maheshwari



S.Y. B.Sc.

Microbiology

Paper No-MI-203: Applied and Environmental Microbiology

Total Marks: 75

UNIT	DETAILED COURSE	TEACHING HOURS
Unit-1	<p>UNIT-1:- Aerobiology and Microbial Interactions. Elements of microbial ecology a. Distribution of microorganisms in nature b. Microbial interactions [Clay-humus-microbe, plant- microbe (above and below ground parts), animal-microbe, microbe-microbe, termite-microbe, fungal-algal] Aerobiology a. Origin, number and kinds of microorganisms present in air b. Methods of enumeration of microorganisms present in air c. Airborne pathogenic organisms & Its diseases d. Air sanitation (Importance in hospitals and their industrial micro-biota) Extreme environments. a. Temperature, High solute concentration, pH as an environmental extreme b. Other environmental extremes : Anoxic Environment c. Archaeobacteria and other microbial flora of extreme environments</p>	15
Unit-2	<p>Microbiology of drinking water and waste water. a. Types of water b. Collection and examination of water c. Water purification – individual and municipal water supplies d. Water – borne diseases e. Chemical and microbiological waste water including BOD and COD f. Waste water treatment processes: • Single dwelling units : Septic tank • Municipal treatment processes</p>	15
Unit-3	<p>Microbiology of Milk and Dairy Products Microbiology of Milk a. Sources of microorganisms in milk b. Qualitative and quantitative examination of milk c. Grading of milk, Pasteurization and methods to check its efficiency d. Undesirable organisms in milk causing spoilage in different ways e. Milk - borne infections Dairy Products a. Cheese b. Butter c. Yoghurt d. Other fermented milk / products</p>	15
Unit-4	<p>Microbiology of Foods a. Microbial flora of fresh foods: [Meats, Poultry - eggs, Fruits and Vegetables, Shellfish and Fin-fish, Milk] b. Intrinsic and extrinsic factors affecting food spoilage c. Food spoilage by : radiation, pressure, freezing, enzymes and organisms c. Microbial control and food preservation techniques including canning process d. Bacteriological examination of food : Microscopic and cultural techniques</p>	15



	e. Fermented foods : Sauerkraut, Pickles and Ensilage f. Food infection and food poisoning	
Unit-5	Pollution and environmental hazards a. Pollution of various ecosystems. (Air, Land, Water, etc) b. Pollution by : Noise, Temperature, Radiation, Heavy metals and Microorganisms c. Dangers of man made materials as polluting agents- e.g. Insecticides, Pesticides. d. Biodegradation of hazardous wastes.	15

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1.	Microbiology (5 th Edition) Pub; McGraw Hill Book Company. N. Y.	- Pelczer M. J., Chan E.C.S. Krieg N.L.R.
2.	Microbiology (International Edition) Concepts and Applications. Pub; McGraw Hill Book Company. N. Y. N. Secondar N.Y.	- Pelczer M. J., Chan E.C.S. Krieg N.R.
3.	Microorganisms in Action: Concepts and Applications in Microbial Ecology. Pub; Black well scientific publications, London.	- Lynch J. M., Hobbie J. B.
4.	General Microbiology (7 th Edition). Pub; Cambridge University Press (Low Price Edition.)	- Hans G. Schlegel
5.	Biology of microorganisms (Brocks') (9 th Edition) 2002 Prentice Hall, Intn Inc. N.Y.	- Madigan, M. T. Martinko & J. Parker.
6.	Environmental Biology and Toxicology (2 nd Edition) Pub; Rastogi Publications, Meerut.	- P. D. Sharma.
7.	Microbiology (2 nd Edition) Pub; Rastogi Publications, Meerut.	- P. D. Sharma.
8.	General Microbiology (5 th Edition) Pub; Macmillan Education Ltd., Hampshire.	- Stanier R. J., Ingraham J. L. Wheelio M. L., Painter P. R.
9.	Microbial Ecology - Fundamental and Applications Pub; Addison - Wesley Publications Co.	- Atlas R. M. Bartha R. London.
10.	Microbiology : Fundamentals and Applications Pub: Macmillan Publishing Co, New York	- Atlas R. M.
11.	Zinsser Microbiology (15 th Edition) Pub: Meredith Corpo Ration, N. Y.	- Joklik W. K. Smith D. T.
12.	Microbiology : Concepts and Applications Pub: John Wiley and Sons, N. Y.	- P. A. Ketchum
13.	Basic Microbiology (5 th Edition) Wheeler M. F.	- Volk W. A.
14.	Microbiology (2 nd Edition) Pub: WCB McGraw	- Lim Dginel Hill, Boston
15.	A textbook of environmental chemistry and pollution control (3 rd Edition) Pub: S. Chand and Company Ltd., New Delhi - 110 055.	- S. S. Dara
16.	Environmental pollution Pub: Anmol Publications Pvt. Ltd., New Delhi - 110 002.	- Timy Katyal, M. Satak Edited by Raj Kumar
17.	Concepts of ecology Pub: Saras Publication, Kanyakumari	- N. Arunugam
18.	Tertiary level biology, Environmental Microbiology Pub: Blackie London	- W. D. Grant P. E. Long.
19.	General Microbiology Vol. I & II. Pub: Himalaya Publishing House, Mumbai	- Dr. C. B. Powar Dr. H.F. Daginawala
20.	Food Microbiology	- Frazier
21.	Dairy Microbiology, Pub: Akta Prakashan	- Prajapati
22.	A text book of microbiology	-R C Dube, D K Maheshwari



S.Y. B.Sc.
Microbiology

Paper No-MI-204: Microbiology Practical

University Annual Examination

Marks: 75

- Practical examination shall be of two days (Daily Six hours, Total 12 hours)
- Journal certified by the Head of the Department has to be presented by the candidate at the time of practical examination.
- Students shall not be allowed without certified journals in the University practical examination.

Total number of exercises to be performed by each candidate will be as under:

Practical Examination Scheme

Marks

1. Isolation and characterization of bacterial culture	10
2. Staining techniques and Mounting of Fungi and Yeasts	15
3. Applied & Environmental Microbiology Exercise	10
4. General Exercise	10
5. Computer based Experiments	05
6. Spotting	10
7. Journal and Slides	05
8. Viva-voce I & II	10
TOTAL	75



MI - 204 Practicals in Microbiology

Total Marks - 75

(1) Introduction to laboratory instruments.

1.1	Microscope	1.2	Autoclave
1.3	Incubator	1.4	Hot-air oven
1.5	Balances	1.6	Refrigerator
1.7	Inspissator	1.8	Shaker
1.9	Colorimeter	1.10	Spectrophotometer
1.11	pH meter	1.12	Anaerobic jar
1.13	Hellige's - Lovibond comparator	1.14	Distillation Plant
1.15	Centrifuge	1.16	Colony counter
1.17	Water-bath		

(2) Cleaning, neutralization and sterilization of glasswares.

(3) Media sterilization.

(4) Disposal of bacteriological wastes and cultures.

(5) Preparation of standard solutions.

- a. Percent solutions.
- b. Molar solutions.
- c. Normal solutions.
- d. Parts per million solutions.

(6) Study of pigment production by some bacteria including its solubility in various solvents.

(7) Effect of physical and chemical factors on the growth of microorganisms.

- a. Effect of pH.
- b. Effect of salt concentration.
- c. Effect of temperature.
- d. Effect of chemicals
- e. Effect of heavy metals
- f. Effect of U. V. light.
- g. Effect of antibiotic Ditch method

(8) Microscopic examination of inanimate objects.

- a. Flour.
- b. Dust particles.
- c. Fabric threads, cotton, wool, silk and man-made fibers.
- d. Chalk particles.
- e. Mineral particles - NaCl and CuSO₄

(9) Microscopic examination of hay infusion.

(10) Microscopic measurements (Micrometry).

(11) Staining of bacteria and bacterial cell structures.

- a. Monochrome staining
- b. Negative staining.
- c. Gram's staining.
- d. Acid-fast staining.
- e. Capsule staining.
- f. Spore staining.
- g. Metachromatic granule staining.
- h. Cell-wall staining.
- i. Fat-body staining.
- j. Nucleus staining.
- k. Spirochete staining.



- 1. Flagella staining.
- (12) Adjustment of pH of culture medium.
 - a. Paper-strip.
 - b. Hellige's Lovibond comparator with pH comparator disk.
 - c. Digital pH meter.
- (13) Study of pure cultures.
 - a. *Enterobacter aerogenes*.
 - b. *Escherichia coli*.
 - c. *Proteus vulgaris* or *Proteus mirabilis*.
 - d. *Salmonella* group
 - e. *Dysentery* group.
 - f. *Pseudomonas aeruginosa*.
 - g. *Serratia marcescens*.
 - h. *Staphylococcus aureus*.
 - i. *Bacillus subtilis*.
- (14) Study of microflora of skin.
- (15) Bacteriological examination (qualitative and quantitative) of :
 - a. Air.
 - b. Water.
 - c. Food.
 - d. Milk.
- (17) Study of metabolic activities of bacteria.
 - a. Degradation of casein.
 - b. Degradation of gelatine by the use of gelatine agar and nutrient gelatine media.
 - c. Amino acid deamination test: study of phenylalanine deamination.
 - d. Lipid hydrolysis test.
 - e. Dehydrogenase test.
 - f. Oxidase test.
 - g. Catalase test.
 - h. Starch hydrolysis test.
- (18) Mounting of fungi and yeast
(1) *Aspergillus*, (2) *Penicillium* (3) *Rhizopus* (4) *Mucor* (5) *Alternaria* (6) *Helminthosporium*
(7) *Cunninghamella* (8) *Neurospora* (9) *Yeast –Saccharomyces cerevisiae* (10) *Fusarium* (11) *Curvularia*
- (19) Determination of Phenol coefficient.
- (20) Computer based experiments: To create branch and linear polymers of sugars, amino-acids and nucleotides by creating appropriate bonds
 - 20.2. Study of complementarity of left and right strands of DNA and RNA
 - 20.3. Study of peptide chain biosynthesis: Transcription and Translation
- (21) Study of permanent slides - Vector

Reference Books:

1.	Mackie and McCartney's Practical Medical Microbiology (14 th Edition)	- Collee J. E., Fraser A. G. Marnion B. P.
2.	Laboratory experiments in Microbiology (5 th Edition)	- Johnson T. R., Cape. C. L.
3.	Laboratory Manual in Biochemistry (1981)	- Jayaranan J.
4.	An introduction to practical biochemistry (3 rd Editio) Pub: McGraw Hill Book Co., U. K. 1987.	- Plummer D. T.
5.	Experimental Microbiology Vol. I & II. Pub: Prion publications, Ahmedabad.	- Rakesh J. Patel Kiran R. Patel
6.	Microbiology A. Practical approach	- Bhavesh Patel, Nandini Phanse