

B.Sc.

Microbiology



**Rayat Shikshan Sanstha's
Yashvantrao Chavan Institute of Science, Satara
(Autonomous)**



Lead College of Karmveer Bhaurao Patil University, Satara

Reaccredited by NAAC with 'A+' Grade

Syllabus For

Bachelor of Science

MICROBIOLOGY

**Syllabus to be implemented w.e. f. June 2023
(As per NEP 2020)**

CONTENT

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Syllabus for B.Sc. I Microbiology

- **PREAMBLE:**

This syllabus is framed to give sound knowledge with understanding of Microbiology to undergraduate students at first year of four years of B.Sc. degree course. Students learn Microbiology as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Microbiology popular, interesting and encouraging to the students for higher studies including research. The new and updated syllabus is based on a basic and applied approach with vigor and depth. The syllabus meets the needs of industries and research. The syllabus is prepared after long discussion with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

- **PROGRAMME OBJECTIVES:**

1. To nurture academicians with focus and commitment to their subject.
2. To create a skilled work force to match the requirements of the industries and research.
3. To develop scientific attitude is the major objective so as to make students open minded, critical and curious.
4. To develop skill in practical work, experiments and laboratory materials and equipment along with the collection and interpretation of scientific data to contribute to science.

- **PROGRAMME OUTCOMES:**

1. The students will graduate with proficiency in the subject of their choice.
2. The students will be eligible to continue higher studies in abroad.
3. The students will be eligible to pursue higher position in industries.
4. The students will be eligible for jobs in government organizations.

- **PROGRAMME SPECIFIC OBJECTIVES:**

Students should be able...

1. To learn fundamental techniques in Microbiology such as culturing microbes, maintaining microbes, safety issues related to handling of microbes, Good Microbiological practices etc
2. To acquire practical skills through the laboratory work, exposure to industries and interaction with industry experts.
3. To develop moderately advanced skills in working with microbes such as pilot scale culturing, downstream processes, diagnostics and advanced techniques in molecular biology etc.
4. To be familiarized with the applicability of knowledge and Interdisciplinary approach in everyday life as well as in various other fields like agriculture, environment, industries such as food and dairy industries, distilleries, pharmaceutical industries, immunology and medical microbiology etc.
5. To become informed citizens who can understand and evaluate the impact of new research discoveries in the life sciences and will be able to pursue a wide range of careers, including biological and medical research in higher education institutions as well as careers in public and global health, scientific writing, environmental organizations, and food, pharmaceuticals and biotechnology industries.

- **PROGRAMME SPECIFIC OUTCOMES (PSO):**

After successful completion of B.Sc. Microbiology Course student will be able to:

1. Explain applications of microorganisms in various field such as agriculture, environment, industries such as food and dairy industries, distilleries, pharmaceutical industries, immunology and medical microbiology etc.
2. Describe the characteristics of different types of microorganisms and methods of their classification, methods of visualizing microorganisms, controlling growth of microorganisms, isolation and maintenance of bacterial cultures immunological concepts with reference to infection and immunity.
3. Apply subject knowledge to solve issues like bioremediation, waste management and diagnostics or to design and execute experiments related to Microbiology, immunology, molecular Biology, recombinant DNA technology, microbial genetics etc.
4. Pursue higher studies in different branches of Microbiology like Medical Microbiology, Industrial Microbiology, Virology, Marine Microbiology, Food Microbiology, etc.
5. Take up a suitable position in myriad sectors like academia, research and development, government sector or in industries like pharmaceuticals, food and beverages, bakery, winery, water testing and treatment, etc.

Four Year UG Honours Degree

Level	Sem	Subject - 1 Major				Subject - 2 Minor		Subject - 3 GE / OE		VSEC		AEC, VEC, IKS			OJT, FP, CEP, CC, RP					Total	Non - CGPA
		DSC		DSE						VSC	SEC	AEC	IKS	VEC	CC	FP	CEP	OJT /Int/ Ap P /RT	RM		
		T	P	T	P																
4.5	I	4	2	---	---	4	2	4	2				2		2	-				22	
	II	4	2	---	---	4	2	4	2		2		---	2		-				22	DEGG
5	III	4	4	---	---	2	2			2	2	4	---	2						22	
	IV	4	4	---	---	2	2			2	2	4	---		2					22	
5.5	V	4	2	4	2	---	-	-	-	4			---		2	2	2			22	
	VI	4	2	4	2	---	-	-	-	2				2	2			4		22	IIC
6	VI	8	2	8			-	-	-	---		---	---			-			4	22	
	VII	8	2	8		---	-	-	-	-		---	---			-		4		22	
Total		4	20	24	4	12	8	12		10	6	8	2	4	8	4	2	8	4	176	
						20		12		16		14			26						

B.Sc. I SEMESTER I

Level	Major DSC	Practical	Minor	Practical Minor	OE/GE T			IKS	CC	Total credits
4.5	Course I - BMiT 111 Introduction to Microbiology	Practical course- I BMiP 113	Course I BMiT 114 Microbial Diversity	Practical course- I BMiP 116	Course I Introduction to Marketing BMiTOE 117	Course II Service and Digital Marketing BMiTOE 118	Course III Democracy, Election and Good Governance BMiTOE 119	BMiTIKS 1 - Introduction to Vedic Microbiology	BMiTCC 1 NSS-Volunteerism	22
	Course II- BMiT 112 Techniques in Microbiology		Course II BMiT 115 Bacteriology I							
Credits	4	2	4	2	4	2		2	2	

B.Sc. I SEMESTER II

Level	Major DSC	Practical	Minor	Practical Minor	OE/GE T			SEC		VEC	Total credits
4.5	Course III BMiT 121 Microbial growth	Practical course- II BMiP 123	Course III BMiT 124 Bacteriology II	Practical course- II BMiP 126	Course IV BMiTOE 127 Market promotion and Service Marketing	Course V BMiTOE 128 Application of Digital Marketing	Course VI BMiTOE 129 Indian Constitution	BMiTSEC 1 Fundamentals in Bioinformatics I	Practical Course	BMiT VEC-II Role of values and Ethics in Microbiology	22
	Course IV BMiT 122 Biomolecules		Course IV BMiT 125 Applied Microbiology								
Credits	4	2	4	2	4	2		1	1	2	
Semester I + Semester II										44	

B.Sc. I SEMESTER I**Major Course****COURSE I: BMiT 111- Introduction to Microbiology****Course objectives:**

The students should be able to ...

1. understand the contribution of scientists in development of microbiology.
2. know scope of microbiology in upcoming areas of biological sciences.
3. study morphological and differential characteristics of different groups of microorganisms.
4. learn the structure and functions of different parts of typical bacterial cell.

Total Credits-2	SEMESTER-I COURSE I: BMiT 111- Introduction to Microbiology	No. of hours per unit
UNIT I	History and Development of Microbiology	8
	a) Theory of abiogenesis and biogenesis b) Contributions of Anton Van Leeuwenhoek, Louis Pasteur, Robert Koch, John Tyndall, Martinus W. Beijerinck, Sergei N. Winogradsky. Paul Ehrlich, Edward Jenner, Joseph Lister.	
UNIT II	Scope and Branches of Microbiology	8
	a) Air Microbiology, Water Microbiology, Sewage Microbiology, Agricultural Microbiology, Food & dairy Microbiology, Industrial Microbiology, Medical Microbiology b) Advanced branches in Microbiology: Pharmaceutical microbiology, Geomicrobiology, Nano-biotechnology and Space Microbiology, Bioinformatics.	
UNIT III	Microbial Diversity	6

	a) Differences in prokaryotic and eukaryotic organisms b) General characteristics of different groups– acellular microorganisms. (Viruses, Viroid and Prions) and cellular microorganisms (Bacteria, Archaeobacteria, Rickettsia, Algae, Fungi and Protozoa) with emphasis on occurrence and economic importance.	
UNIT IV	Bacterial Cell Organization	8
	Structures of typical bacterial cell a) Cell wall: Structure, function and chemical composition b) Cell membrane: Structure, function and chemical composition c) Capsule and slime layer: Structure, composition and function d) Flagella: Structure, composition and function e) Pili: Structure, composition and function f) Cytoplasm: Ribosomes, mesosomes, nucleoid material	

Course outcomes:

The student will be able to...

1. explain the contribution of scientists in development of microbiology.
2. describe the scope of microbiology in upcoming areas of biological sciences.
3. examine morphological and differential characteristics of different groups of microorganisms.
4. evaluate the structure and functions of different parts of typical bacterial cell.

Reference Books:

1. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology. 8th Edition. McGraw-Hill Higher Education.
2. Powar, C.B., Daginawala H.F. (2010). General Microbiology. Himalaya Publications.
3. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc.
5. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology. 6th Edition. McGraw Hill Higher Education.
6. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill

Companies Inc.

7. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
8. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology. 5th Edition, Tata MacGraw Hill Press.
9. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology. 5th Edition. Macmillan Press Ltd.
10. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.
11. Frobisher M, Fundamentals of Microbiology (1962) W. B. Saunders, Philadelphia. 7th edition.

B.Sc. I SEMESTER I

COURSE II : BMiT 112-Techniques in Microbiology

Course objectives:

The students should be able to...

1. understand the principle, working and applications of light and electron microscopic techniques.
2. study various morphological forms of bacteria using simple and special staining techniques.
3. learn the mode of action and application of different sterilizing agents and disinfectants.
4. know principle and working of chromatography, colorimeter and electrophoresis.

Total Credits -2	SEMESTER-I COURSE II : BMiT 112 Techniques in Microbiology	No. of hours per unit
UNIT I	Microscopy	8
	a) Terms in microscopy - Magnification, Refractive index, Numerical aperture, Resolving power b) Types of Microscopes - i) Light Microscope - Types: Bright field, Dark field, Phase contrast, fluorescent microscope Compound Microscope: Parts, image formation, Ray diagram and applications. ii) Electron Microscope - Parts, principle of image formation, Ray diagram and applications. iii) Comparative study of compound and electron microscope.	
UNIT II	Stain and Staining Techniques	8
	a) Definition of dye, stain, fixative, mordant, accentuators, decolorizing agent. Classification of stain: acidic, basic and neutral. b) Common staining techniques-Principle, procedure, mechanism and application of simple staining, negative staining, differential staining- Gram and acid-fast staining, impregnation method. c) Special staining methods - Cell wall, Capsule and Volutin granules	

UNIT III	Control of microorganisms	8
	a) Definitions- sterilization, disinfection, Antiseptic, Germicide, Microbiostasis Antisepsis & sanitization. b) Physical agents of control of microorganisms- Temperature (dry heat and moist heat), Filtration -asbestos and membrane filter, Radiations- U.V Rays, Gamma Rays Checking of efficiency of Sterilization Biological and Chemical indicators b) Chemical agents for control of microorganisms- mode of action, applications and advantages of Phenolic and phenolic compound, Alcohol (Ethyl alcohol), Halogen compounds (Chlorine & Iodine), Heavy metal (Cu and Hg)	
Unit IV	Analytical techniques	6
	Principle, working and applications of a) Chromatography b) Spectrophotometer c) Electrophoresis	

Course outcomes:

The students will be able to ...

1. compare the principle, working and applications of light and electron microscopic techniques.
2. identify various morphological forms of bacteria using simple and special staining techniques.
3. specify the mode of action and application of different sterilizing agents and disinfectants.
4. analyze different samples of biomolecules by using chromatography, colorimeter and electrophoresis.

Reference Books:

1. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8th Edition, McGraw-Hill Higher Education
2. Powar, C.B., Dagainawala H.F. (2010) General Microbiology, Himalaya Publications.
3. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc
5. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education.

6. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.
7. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
8. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.
9. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
10. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.
11. Frobisher M, Fundamentals of Microbiology (1962) 7th edition. W. B. Saunders, Philadelphia.

B.Sc.I Semester I
BMiP 113-Practical Course I

Course objective:

Students should be able to...

1. learn the safety measures while working in the microbiology laboratory and handling of microscope.
2. know preparation of stains, buffer, reagents & physiological saline.
3. study bacterial morphology using various staining procedures.
4. understand the observations of all experiments.

Total Credits-2	SEMESTER-I BMiP 113- Practical Course I (Based on BMiT 111 and BMiT 112)	No. of hours (60)
	<ol style="list-style-type: none"> 1) Demonstration of basic techniques in Microbiology: Wrapping of glassware, cotton plugging, cleaning and washing glassware, biological waste disposal. 2) Introduction and use of common laboratory glass ware: Test tubes, culture tubes, suspension tubes, screw capped tubes, Petri Plates, pipettes, Erlenmeyer flask, Volumetric Flask, Glass spreader, Durham's Tube, Cragie's Tube, inoculating needles (Wire Loop, stab needles) 3) Study of biosafety- aseptic techniques, table disinfection, hand washing, use of apron, proper disposal of used material, cleaning and sterilization of glassware 4) Use, care and study of compound microscope. 5) Demonstration/Working principle and application of laboratory equipments - Incubator, Autoclave, Hot air oven, Membrane filter, Distilled water plant 6) Preparation of: <ol style="list-style-type: none"> a) Stains (0.5% basic fuchsin & 0.5% crystal violet), b) Buffer (Phosphate buffer pH 7.0), c) Reagents (1N and 1M HCl and NaOH Solutions), d) Physiological Saline 	

	7) Observation of morphology of bacteria by Monochrome staining method 8) Observation of morphology of bacteria by Negative staining method 9) Study of gram nature of bacteria by Gram staining. 10) Observation of motility by Hanging drop technique. 11) Demonstration of Acid fast staining - Permanent slide only. 12) Observation of bacterial capsule staining by Maneval's method 13) Observation of bacterial cell wall staining by Chance's method. 14) Observation of bacterial volutin granule staining by Albert's method 15) Wet mount preparation of fungus.	
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Course outcomes:

Students will be able to...

1. demonstrate the safety measures in the microbiology laboratory and handling of microscope and laboratory instruments.
2. demonstrate basic techniques in microbiology like wrapping of glasswares, cotton plugging etc.
3. prepare stains, buffer, reagents & physiological saline.
4. examine bacterial morphology using various staining procedures.

Reference Books:

1. Arora B. and Arora D. R. (2020). Practical Microbiology. CBS Publishers and Distributors, New Delhi, India.
2. Dubey R. C. and Maheshwari D. K. (2012). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
3. Atlas R. M. (2010). Handbook of Microbiological Media. Ukraine: Taylor and Francis.
4. Patel R. (2009) Experimental Microbiology. Aditya Book Centre 5th edition, Vol. I and Vol.II,
5. Goldman E., and Green L. (2008) Practical Handbook of Microbiology, Taylor & Francis.
6. Cruick S.R., Dugaid, J.P., Marmion, B.P. and Swain, R.H. (1980) Medical Microbiology, Churchill Livingstone Publishing, Edinburgh, Vol. 1 & 2, 12th Edition.
7. Baker F. J. (1967) Bacteriological techniques, Butter worth & Co Publishers Ltd.

B.Sc. I SEMESTER I**Minor Course****COURSE I –BMiT 114: Microbial Diversity****Course objective:**

The students should be able to ...

1. understand the concept of microbiology and types of microorganisms.
2. know the contributions of scientists in microbiology.
3. learn the classification of bacteria and different branches of microbiology.
4. understand the applications of microbiology in various fields.

Total Credits 2	SEMESTER-I Course I -BMiT 114: Microbial Diversity	No. of hours per unit
UNIT I	Microbial Diversity	7
	a) Concept of Microbiology b) Types of Microorganisms and their differentiating characters with examples. c) Prokaryotes, Eukaryotes, three domain and five domain system of classification d) Bacteria (Eubacteria and Archaeobacteria) , Protozoa , Fungi , Algae, Viruses, Viroids and Prions , Actinomycetes.	
UNIT II	History of Microbiology	8
	a) Development of microbiology as a discipline -Discovery of microscope and Microorganisms b) Contribution of: Anton von Leeuwenhoek and Robert Hooke, Louis Pasteur, Robert Koch, Joseph Lister, Paul Ehrlich, Elie Metchnikoff, Edward Jenner and Alexander Fleming.	

UNIT III	Classification and Nomenclature of Microorganisms	8
	a) Taxonomic Ranks b) Common or Vernacular name c) Scientific or International Name d) Whittaker's five Kingdom and Carl Woese's Three Kingdom Classification System e) Classification of microorganisms: - Based on temperature, PH, Pressure, Mode of nutrition.	
UNIT IV	Applications of Microorganisms	7
	a) Beneficial and harmful effects of microorganisms b) Applications of microorganisms in Food, Health, Cosmetics, Biofuel, Waste treatments, Beverages, Medical, Agricultural, etc.	

Course outcomes:

Student will be able to...

1. classify the microorganisms on basis of their characteristics.
2. describe the contributions of scientists in microbiology.
3. explain scope and different branches of microbiology.
4. apply knowledge of microbiology in various fields.

Reference Books:

1. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8th Edition, McGraw-Hill Higher Education
2. Powar, C.B., Daginawala H.F. (2010) General Microbiology, Himalaya Publications.
3. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc
5. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education.
6. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill

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7. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
8. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.
9. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
10. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.
11. Frobisher M, Fundamentals of Microbiology (1962) W. B. Saunders, Philadelphia. 7th edition.

B.Sc. I SEMESTER I

COURSE: II BMiT 115- Bacteriology I

Course objectives:

The students should be able to...

1. learn the structure and organization of bacterial cells.
2. study the bacterial staining techniques.
3. understand mechanisms of different sterilization methods.
4. know the applications of disinfectants to avoid contamination.

Total Credits=2	SEMESTER-I Course II : BMiT 115- Bacteriology I	No. of hours per unit
UNIT I	Bacterial Cytology	7
	a) Morphology- Size, shape, Arrangement of bacteria. b) Structure, chemical composition and functions of Cell wall – Gram positive & Gram-negative Bacteria, Cell membrane, Mesosomes, Capsule, slime layer, Surface appendages – flagella, pili.	
UNIT II	Stains and Staining Techniques.	8
	a) Definition of dye and stain. b) Classification of stain – acidic, basic and neutral. c) staining techniques- Principle, procedure, mechanism and application of simple staining, negative staining, differential staining- Gram and acid-fast staining.	
UNIT III	Sterilization Techniques	8
	a) Physical Agents and their working principle - Heat, Radiation, Filtration, Low temperature, Drying. b) Efficiency of sterilization (Dry and Moist) – Biological and Chemical Indicators.	

UNIT IV	Disinfection and Antiseptics	7
	Disinfection: a) Chemical agents and their mode of action -Aldehydes, Halogens, Quaternary ammonium compounds, Phenol and phenolic compounds, b) Heavy metals, Alcohol, Dyes, Detergents and Ethylene oxide.	

Course outcomes :

Student will be able to...

1. identify the different components of bacteria.
2. describe morphology of microorganisms by performing different staining techniques.
3. apply different sterilizing techniques to avoid contamination.
4. demonstrate the action of disinfection and antiseptics.

Reference Books:

1. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8th Edition, McGraw-Hill Higher Education
2. Powar, C.B., Dagainawala H.F. (2010) General Microbiology, Himalaya Publications.
3. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc
5. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education.
6. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.
7. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
8. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.
9. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
10. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.

B.Sc. I SEMESTER I

BMiP 116-Practical Course -I

Course objectives:

The students should be able to...

1. know good laboratory techniques and safety measures in laboratory.
2. learn basic techniques in microbiology.
3. understand principle and working of laboratory instruments.
4. study the bacterial staining techniques.

Total Credits=2	SEMESTER-I BMiP 116 : Practical Course I (Based on BMiT 114 and BMiT 115)	No. of hours (60)
	<ol style="list-style-type: none"> 1. Demonstration of basic techniques in Microbiology: Wrapping of glassware, cotton plugging, cleaning and washing glassware, biological waste disposal. 2. Study of common laboratory glass wares: Test tubes, Petri Plates, pipettes, Erlenmeyer flask, Volumetric Flask, Glass spreader, Durham's Tube, inoculating needles (Wire Loop) 3. Study of safety measures and Good Laboratory Practices in microbiology laboratory 4. Demonstration of aseptic techniques, Table disinfection, Hand Washing, Use of Apron, Proper disposal of used material, Cleaning and sterilization of glassware. 5. Operation, precautions and use of Incubator, anaerobic jar. 6. Operation, precautions and use of Hot air oven, Autoclave. 7. Operation, precautions and use of Colorimeter, Laminar air flow hood, Clinical centrifuge. 8. Use, care and study of compound microscope. 9. Permanent slide observation: Algae, Fungi and Protozoa. 10. Observation of Algae, Fungi and Protozoa by wet mount preparation. 11. Microscopic Examination of Bacteria by Monochrome staining method. 	

	12. Microscopic Examination of Bacteria by Negative staining method. 13. Microscopic Examination of Bacteria by Gram staining method. 14. Bacterial capsule staining by Maneval's method 15. Bacterial cell wall staining by Chance's method.	
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Course outcomes:

Students will be able to...

1. apply good laboratory techniques and safety measures in laboratory.
2. demonstrate basic techniques in microbiology like wrapping of glasswares, cotton plugging etc.
3. operate laboratory instruments.
4. observe morphology and different parts of bacteria by performing different staining techniques.

Reference Books:

1. Arora B. and Arora D. R. (2020). Practical Microbiology. CBS Publishers and Distributors, New Delhi, India.
2. Dubey R. C. and Maheshwari D. K. (2012). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
3. Atlas R. M. (2010). Handbook of Microbiological Media. Ukraine: Taylor and Francis.
4. Patel R. (2009) Experimental Microbiology. 5th edition, Vol. I and Vol. II. Aditya Book Centre.
5. Goldman E., and Green L. (2008) Practical Handbook of Microbiology. Taylor & Francis.
6. Cruick S.R., Dugaid, J.P., Marmion, B.P. and Swain, R.H. (1980) Medical Microbiology, Vol. 1 & 2, 12th Edition. Churchill Livingstone Publishing, Edinburgh.
7. Baker F. J. (1967) Bacteriological techniques, Butter worth & Co Publishers Ltd.

B.Sc.I SEMESTER – I**Open Elective (OE)-I****Course Title: Digital Marketing****Course I: BMiTOE 117 - Introduction to Marketing****Course objectives:**

Students should be able to ...

1. learn the features of marketing and its importance.
2. know the various marketing concepts
3. study the various components and process of market segmentation.
4. understand market targeting and positioning.

Total Credits =2	SEMESTER– I OE Course – I BMiTOE 117 - Introduction to Marketing	No. of hours per unit
Unit - I	Introduction of Marketing:	08
	a) Meaning & Definition b) Features of Marketing c) Importance of Marketing d) Scope of marketing	
Unit – II	Concept of Marketing-	08
	a) Need, Want, Demand, Value, cost and Satisfaction, Exchange, transactions & Relationship Marketing b) Holistic & Domestic Marketing concept	
Unit – III	Market Segmentation	08
	a) Market Segmentation: Meaning and definition, Process of segmentation, Nature and bases of segmentation	
Unit - IV	Market Targeting and Positioning:	06
	a) Targeting: Meaning & concepts, Process and types b) Positioning: Meaning and concept, importance	

Course outcomes:

Students will be able to...

1. acquaint with the meaning and importance of marketing.
2. discuss the various concepts of marketing.
3. explain the process of market segmentation.
4. apply the understanding of market targeting and market positioning.

Reference books:

1. Dr. K. Karunakaran (2013) Marketing management (text and cases in India context), Himalaya Publishing House- 3rd edition.
2. Roger Cox and Pual Brittain (2006) Retailing: an Introduction- Pearson Education Publishing, 15th edition.
3. Krishna K. Havaladar and Vasant m. Cavale, (2010) Sales and Distribution Management (text and cases), Mc Graw Hill Education Pvt. Ltd., 11th edition.
4. Indian Journal of Marketing, Satya Gilani on behalf of Associated Management Consultant Pvt. Ltd www.indianjournalofmarketing.com

B.Sc.I SEMESTER – I**Open Elective (OE)****Course Title: Digital Marketing****Course I: BMiTOE 118 - Service and Digital Marketing****Course objectives:**

Students should be able to ...

1. understand the basic concept of consumer behaviour.
2. know the factors affecting consumer behaviour.
3. study the advantages and disadvantages of e- marketing.
4. learn the benefits of digital marketing.

Total Credits 2	SEMESTER – I Course – II BMiTOE 118– Service and Digital Marketing	No. of hours per unit
Unit - I	Consumer Behavior	08
	a) Consumer Behavior: Meaning and Significance, Scope of Consumer Behavior, Factors affecting Consumer Behavior, Buying Decision process	
Unit – II	CRM	08
	a) Meaning and Definition b) Features of CRM c) CRM Techniques d) CRM Programmes e) Retaining Customers	
Unit – III	E- Marketing	08
	a) Introduction, Definition and Meaning of E-Marketing b) Utility of E- Marketing c) Advantages of E- Marketing. d) Disadvantages of E-Marketing	
Unit - IV	Introduction to Digital Marketing	06
	a) Meaning and Definition, b) Types of Digital Marketing	

	c) Factors Influencing Online Marketing d) Benefits of Digital Marketing e) Digital Marketing V/S Traditional Marketing	
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Course outcomes:

Students will be able to....

1. acquaint with the factors affecting consumer behavior.
2. discuss contemporary issues in service marketing
3. describe advantages and disadvantages of e-marketing
4. explain benefits of digital marketing.

References Books:

1. Tracy L.Tuten, Michael R.Solomon- Social Media Marketing ,Sage Publication, New Delhi.
2. Harsh V.Verma, Services Marketing Text and Cases,Dorling kindersley(India pvt), 482 FIE, Patpargang, Delhi, 11009
3. Digital Marketing – kamat and Kamat- Himalaya
4. Digital Marketing- V. Ahuja, Oxford University Press
5. Digital marketing, S. Gupta, Mc Graw- Hill

B.Sc. I Semester I
Indian Knowledge System (IKS)
Title of Course : Vedic Microbiology

BMiTIKS 1- Introduction to Vedic Microbiology

Course objectives:

Students should be able to...

1. study the concept of Veda.
2. know contribution of rishis or gurus in Vedic Microbiology.
3. understand microbiological phenomenon explained in Vedas
4. learn scientific approach behind traditional Indian Knowledge

Total Credits 2	SEMESTER – I BMiTIKS 1 Introduction of Vedic Microbiology	No. of hours per unit
Unit - I	Vedic Microbiology a) Introduction b) Vedas: Types and features c) Origin of earth with reference to Vedas	(08)
Unit – II	Gurus of Vedic Microbiology a) Term Rishi and Guru b) Vedic Rishies pertaining to Microbiology: Agastya, Rishi Kanv, Rishi Badrayani, Rishi Charak , Maharishi Susruta	(08)
Unit – III	Microbiology in Vedas a) Different terms used for Microorganisms in Vedas b) Concept of Fermentation in Vedas c) Methods for control of microorganisms as described in Vedas - Effect of ‘Agnihotra’ on microorganisms	(08)
Unit - IV	Vedic Mantras Pertaining to Microbiology a) Sukta and its importance b) Different Sukta describing microbiology and their role	(06)

Course outcomes:**Students will be able to...**

1. explain vedic knowledge in microbiology.
2. recall the contribution of vedic rishis in microbiology.
3. evaluate different traditional methods for control of microorganisms.
4. describe vedic mantras describing microorganisms.

Reference Books:

1. Dubey R.C. (2021) Vedic Microbiology: A Scientific View. India: Motilal Banarasadass.
2. Anjista C.F. Kurup S. (2007) Vedic Microbiology: Gurus of Vedic Microbiology. Indian foundation for vedic science, Rohtak.

B.Sc.I SEMESTER II

Major course

COURSE III: BMiT 121 Microbial growth

Course objectives

The students should be able to...

1. understand different phases and pattern of microbial growth and enumerate microorganisms by different methods.
2. learn the classification of microorganisms on basis of their nutritional requirements.
3. know the composition of culture medium for bacteria.
4. study isolation and preservation of microorganisms by suitable methods.

Total Credits=4	SEMESTER-II Course III: BMiT 121 Microbial growth	No. of hours per unit
UNIT I	Microbial growth	8
	a) Modes of cell division: Binary division, budding, fragmentation b) Growth curve- phases, Diauxic growth and Synchronous growth c) Kinetics of bacterial growth (Exponential growth model) d) Measurement of bacterial growth- Microscopic methods -Direct microscopic count, counting cells using improved Neubauer chamber, Plate counts (Total viable count), Turbidometric methods	
UNIT II	Microbial Nutrition	8
	a) Nutrition requirement of microorganisms-Water, Macronutrients and Micronutrients b) Types of microorganisms depending on growth factors – auxotrophs, prototrophs, fastidious organisms. c) Nutritional types of microorganisms depending on carbon and energy source.	
Unit III	Culture Media: 28	8

	a) Common components of culture media and their functions. b) Types of media based on consistency– Liquid, Solid, Semisolid, Biphasic c) Types of culture media– Natural and Synthetic, Semisynthetic, Differential, Enriched, Enrichment, Selective, Transport, Indicator media.	
Unit IV	Cultivation of Microorganisms	6
	a) Pure culture techniques - Serial dilution technique, streak plate technique, spread plate technique, pour Plate technique b) Preservation of microbial culture - sub culturing, overlaying with mineral oils, Lyophilization c) Cultivation of an aerobic bacteria by using media components and by exclusion of air or oxygen.	

Course outcomes

The students will be able to...

1. compare different phases and pattern of microbial growth.
2. classify the microorganisms on basis of their nutritional requirements.
3. design specific growth medium for a particular group of bacteria.
4. isolate and preserve the pure culture by using suitable techniques.

Reference Books:

1. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8th Edition, McGraw-Hill Higher Education
2. Powar, C.B., Dagainawala H.F. (2010) General Microbiology, Himalaya Publications.
3. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc
5. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education.
6. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.

7. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
8. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.
9. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
10. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.
11. Frobisher M, Fundamentals of Microbiology (1962) W. B. Saunders, Philadelphia. 7th edition.

B.Sc.I SEMESTER II

COURSE IV: BMiT 122- Biomolecules

Course objectives :

The students should be able to ...

1. study the structures of different monosaccharides and polysaccharides.
2. learn the primary, secondary, tertiary and quaternary structures of protein.
3. understand Watson and Crick's double stranded model of DNA and study the structure and function of three forms.
4. know classification of lipids based on their composition.

Total Credits=2	SEMESTER-II Course IV:BMiT 122- Biomolecules	No. of hours per unit
UNIT I	Carbohydrates	8
	a) Definition, classifications and brief account of Monosaccharides -Structure of glucose, fructose. Disaccharides - Structures of lactose and sucrose. Polysaccharides - Structures of starch and cellulose.	
UNIT II	Proteins	8
	a) Amino acids- the building blocks of proteins, General formula and classification of amino acids, concept of zwitterion. b) Structure of protein: Primary structure of proteins, secondary structure of proteins (alpha helix, β pleated sheet), tertiary and quaternary structure of proteins. c) Enzyme: Definitions, Structure - Concept of apoenzyme, coenzyme, cofactor, prosthetic group and active site Types- extracellular, intracellular, constitutive and inducible enzyme	
UNIT III	Nucleic Acids	8
	a) DNA: Composition- Structure of Purines, Pyrimidines, Structure of nucleoside, nucleotide, Structure of DNA (Watson and Crick's double helical model), salient features	

	b) RNA - Composition, Structure and function of mRNA, tRNA, rRNA	
UNIT IV	Lipids	6
	a) Simple Lipids- Fats and oils, waxes b) Compound Lipids- Phospholipids, Glycolipids c) Derived lipids	

Course outcomes:

Student will be able to...

1. draw the structures of different monosaccharides and polysaccharides.
2. compare the primary, secondary, tertiary and quaternary structures of protein.
3. describe Watson and Crick's double stranded model of DNA and compare structure and functions of three forms of RNA
4. classify lipids based on their composition.

Reference Books:

1. Satyanarayana U., Chakrapani U. (2013) Biochemistry. 4th Edition. Elsevier, India.
2. Berg, M.J. Tymoczko L.J., and Stryer L. (2010) Biochemistry. 7th edition. H Freeman, New York.
3. Nelson D.L. Lehninger A.L. Michael M.C. (2008.) Lehninger Principles of Biochemistry. 5th Edition .Palgrave Macmillan.
4. Sadasivam S. Manickam A (2007) Biochemical Methods, New Age International (P) Limited.
5. Powar C. B. and Dagainawala H. I. (2005). General microbiology Volume I. Himalaya Publishing House Private Limited, Pune, India.
6. Powar C. B. and Dagainawala H. I. (2005). General microbiology Volume II. Himalaya Publishing House, Private Limited, Pune, India

B.Sc.I SEMESTER II
BMiP 123 -Practical Course II

Course objectives:

Student should be able to...

1. know to weigh ingredients, adjust the pH of medium and operate the autoclave.
2. learn various techniques of isolation.
3. understand biochemical characteristics of bacteria.
4. study qualitative analysis of carbohydrate.

Total credits =2	SEMESTER-II BMiP 123 -Practical Course II (Based on BMiT 121 and BMiT 122)	No. of hours (60)
	<ol style="list-style-type: none"> 1. Demonstration of laboratory equipments - Colorimeter, laminar air flow, anaerobic jar, pH meter, electronic balance, colony counter. 2. Preparation and sterilization of nutrients broth, MacConkey's agar, Sabouraud's agar. 3. Enumeration of bacteria from fermented food / soil / water samples by pour plate technique 4. Enumeration of bacteria from fermented food / soil / water samples by spread plate technique. 5. Isolation of bacteria by streak plate technique. (Colony and cultural characteristics) 6. To detect the ability of bacteria to produce amylase enzyme. 7. To detect the ability of bacteria to produce catalase enzyme. 8. To detect the ability of bacteria to produce caseinase enzyme. 9. To check the ability of microorganism to ferment sugar. 10. To check the ability of microorganisms to produce H₂S. 11. Qualitative analysis of biomolecules Carbohydrate. <ol style="list-style-type: none"> i) General Test for Carbohydrate- Molisch Test ii) Test for Reducing Sugar – Benedict's Test iii) Test for Non reducing Sugar- Benedict's Test iv) Test for Starch- Iodine Test 12. Qualitative analysis of biomolecules 	

	Proteins. i) Detection of Protein by Biuret Test ii) Acetic Acid Test 13. Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram Staining and motility of <i>E. coli</i> 14. Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram Staining and motility of <i>Bacillus species</i> 15. Isolation of pure cultures of bacteria by four quadrant streaking method and study of colony characteristics, Gram Staining and motility of <i>Staphylococcus aureus</i> .	
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Course outcomes:

Students will be able to...

1. prepare and sterilize culture media.
2. perform various techniques of isolation of bacteria.
3. operate instruments in Microbiology laboratory.
4. detect protein and carbohydrates in samples.

Reference Books:

1. Arora B. and Arora D. R. (2020). Practical Microbiology. CBS Publishers and Distributors, New Delhi, India.
2. Dubey R. C. and Maheshwari D. K. (2012). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
3. Shivashankara A.R., Ganesh M.K., Shivaraja Shankara Y.M. (2012) Laboratory Manual for Practical Biochemistry. India: Jaypee Brothers Medical Publisher Pvt. Ltd.
4. Jayraman J. (2011) Laboratory Manual of Biochemistry. India: New Age International publisher.
5. Atlas R. M. (2010). Handbook of Microbiological Media. Ukraine: Taylor and Francis.
6. Singh R., Sawhney S. K. (2005) Introductory Practical Biochemistry. UK: Alpha Science International.
7. David T. Plummer (1993) An Introduction to Practical Biochemistry, 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi

B.Sc. I SEMESTER II

Minor course

COURSE III: BMiT 124 Bacteriology II

Course objectives:

The students should be able to...

1. study nutritional requirements of microorganisms.
2. understand the preparation and uses of culture media in for cultivation of microorganisms.
3. learn the different techniques used for bacterial isolation.
4. know of systematics of pure culture of microorganisms.

Total Credits=2	SEMESTER-II Course III: BMiT 124- Bacteriology II	No. of hours per unit
UNIT I	Microbial Nutrition	8
	a. Nutritional requirements and nutritional classification Micronutrients and Macronutrients. b. Design and preparation of media: Common ingredients of media and types of media c. Methods for cultivating photosynthetic, extremophilic and chemolithotrophic bacteria, anaerobic bacteria, algae, fungi, actinomycetes.	
UNIT II	Culture Media	8
	a. Common components of culture media and their functions. b. Types of media based on consistency– Liquid, Solid, Semisolid, Biphasic c. Types of culture media– Natural and Synthetic, Semisynthetic, Differential, Enriched, Enrichment, Selective, Transport, Indicator media.	
UNIT III	Bacteriological Techniques	7
	a. Concept of Enrichment, Pure Culture, Isolation of culture by streak plate, pour plate, spread plate.	

	b. Maintenance of stock cultures - agar slants and agar stabs. c. Preservation of microbial culture - sub culturing, overlaying with mineral oils, Lyophilization.	
UNIT IV	Systematic Study of Pure Culture	7
	a. Morphological characteristics b. Cultural characteristics: Colony characteristics on solid medium, growth in liquid media and on agar slant. c. Biochemical Characteristics	

Course outcomes:

Student will be able to...

1. classify microorganisms on the basis of their nutritional requirement.
2. design culture media for cultivation of microorganisms in laboratories.
3. isolate microorganisms by the different techniques of isolation.
4. apply the systematic of pure culture for identification of microorganisms.

Reference Books:

1. Willey J. M., Sherwood L. M. and Woolverton C. J. (2013) Prescott's Microbiology, 8th Edition, McGraw-Hill Higher Education
2. Powar, C.B., Dagainawala H.F. (2010) General Microbiology, Himalaya Publications.
3. Madigan M.T., Martinko J.M. (2006). Brock's Biology of Microorganisms. 11th Edition. Pearson Education Inc.
4. Tortora G.J., Funke B.R., Case C.L. (2006). Microbiology: An Introduction. 8th Edition. Pearson Education Inc
5. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, 6th Edition, McGraw Hill Higher Education.
6. Prescott L.M., Harley J.P., and Klein D.A. (2005). Microbiology, 6th Edition. MacGraw Hill Companies Inc.
7. Ingraham J. L. and Ingraham C.A. (2004). Introduction to Microbiology. 3rd Edition. Thomson Brooks / Cole.
8. Michael J Pelczar, JR. E.C.S. Chan, Noel R. Krieg. (1993) Microbiology, 5th Edition, Tata MacGraw Hill Press.

9. Stanier R.Y., Adelberg E.A. and Ingraham J.L. (1987) General Microbiology, 5th Edition. Macmillan Press Ltd.
10. Salle A.J. (1971) Fundamental Principles of Bacteriology. 7th Edition. Tata MacGraw Hill Publishing Co.
11. Frobisher M, Fundamentals of Microbiology (1962) 7th edition..W. B. Saunders, Philadelphia.

B.Sc. I SEMESTER II

COURSE IV- BMiT 125 : Applied Microbiology

Course objectives:

The students should be able to...

1. understand the microflora of air, water, soil and milk.
2. study the health effects associated with air, water, milk borne microorganisms.
3. know beneficial and harmful effects of microorganisms in air, water, soil and milk.
4. learn the techniques used for bacteriological examination of air, water, milk and soil.

Total Credits=2	SEMESTER-II Course IV:BMiT 125 - Applied Microbiology	No. of hours per unit
UNIT I	Air Microbiology	8
	a) Microflora of air: Sources, distribution, Number, and kinds of microorganisms in air . b) Air as a carrier of microorganisms. Droplet, droplet nuclei, Dispersal of Microorganisms in air. c) Techniques for microbiological analysis of air (air sampling) d) Significance of air flora in human health (air borne infections), hospitals, industries.	
UNIT II	Water Microbiology	8
	a) Microbial communities in natural water : sources and typical flora, faecal pollution, indicators of faecal pollution faecal and non faecal coliforms b) Bacteriological examination of water: Standard plate count (SPC), Qualitative tests for coliforms: Presumptive, confirmed, completed test, Quantitive tests for coliforms:Most Probable Numbet (MPN) test. c) Water borne infections.	

UNIT III	Soil Microbiology	7
	a) Soil as an environment as a culture medium Microbiota of soil-their activities b) Brief account of microbial interactions: i) Definitions of Symbiosis, mutualism, commensalism, competition, synergism, satellitism, predation, parasitism. ii) Microbe-microbe interactions (Protozoa-Algae; Lichen) iii) Plant-microbe interactions (Phyllosphere; leg-plant-Rhizobium) iii) Animal-microbe interactions (Rumen; Bioluminescence).	
UNIT IV	Milk Microbiology	7
	a) Definition and composition of milk, sources of microbial contamination in milk, desirable and undesirable changes carried out by microorganism in milk. b) Microbial spoilage of milk. c) Microbial examination of milk: Standard plate count, Dye reduction test, Direct microscopic count d) Pasteurization of milk: methods, efficiency of pasteurization - phosphatase test.	

Course outcomes :

Student will be able to...

1. describe the microflora of air, water, soil and milk.
2. classify microbial infections transmitted through air and water.
3. explain the beneficial and harmful effects of microorganisms in air, water, soil and milk.
4. apply different techniques for bacteriological examination of air, water, milk and soil.

Reference Books :

1. Pareek R. P. and Pareek N. (2019). Agricultural Microbiology. Scientific Publishers, Jodhpur, Rajasthan, India
2. Pawar C. B. and Daginawala H. F. (2019). General Microbiology. Volume I. Second Edition. Himalaya Publishing House, Mumbai. ISBN: 9789350240892
3. Pawar C. B. and Daginawala H. F. (2019). General Microbiology. Volume II. Second Edition. Himalaya Publishing House, Mumbai. ISBN: 9789350240908

4. Subba Rao N. S. (2016). *Advances in Agricultural Microbiology*. Netherlands: Elsevier Science.
5. Tortora G. J., Funke B. R. and Case C. L. (2016). *Microbiology: An introduction* 12th Edition, Pearson. ISBN: 9780321929150
6. Aithal S. C. and Kulkarni N. S. (2015). *Water microbiology ~ an Indian perspective*. 1st Edition. Published by Himalaya Publishing House. ISBN: 9789352021291.
7. Ingraham J. L. and Ingraham C. A. (2000). *Introduction to Microbiology*. United Kingdom: Brooks/Cole. ISBN: 9780534552244
8. Dubey R. C. and Maheswari D. K. *Textbook of Microbiology*. (2000). S. Chand Publishing, New Delhi. ISBN: 978812191803
9. Salle A. J. (1973) *Fundamental Principles of Bacteriology*. New York and London: McGraw-Hill Book Co.
10. Frobisher M. (1974). *Fundamentals of Microbiology*. 9th Edition. Saunders, Michigan University Press. ISBN: 9780721639222
11. MPCB, CPCB, BIS and WHO websites guidelines for drinking water quality

B.Sc. I SEMESTER II
BMiP 126-Practical Course II

Course objectives:

The students should be able to...

1. understand the microbial sampling of air.
2. learn the bacteriological examination of water.
3. know the testing of wastewater by physiochemical parameters.
4. study the isolation of bacteria by pour plate, spread plate and streak plate technique.

Total Credits=2	SEMESTER-II BMiP 126-Practical Course II (Practicals based on BMiT 124 and BMiT 125)	No. of hours (60)
	<ol style="list-style-type: none"> 1. Preparation and sterilization of nutrients broth, MacConkey's agar, Sabouraud's agar. 2. Isolation of <i>E.coli</i> from sewage. 3. Isolation of <i>Salmonella</i> from clinical sample. 4. Isolation of microorganisms from soil. 5. Study of biochemical characters- <ol style="list-style-type: none"> i) Sugar fermentation tests ii) H₂S production test iii) Production of amylase enzyme iv) Production of catalase enzyme 6. Enumeration of microorganisms from water/soil/food samples by spread plate technique. 7. Enumeration of microorganisms from water/soil/food samples by pour plate technique. 8. Study of air microflora and determination of sedimentation rate. 9. Bacteriological examination of water by performing following tests: <ol style="list-style-type: none"> i. MPN ii. Presumptive test. iii. confirmed test. iv. completed test. 10. Determination of BOD of waste water. 11. Determination of COD of waste water. 	

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Course outcomes:

Student will be able to ...

1. Isolate microorganisms by performing streak, spread and pour plate technique.
2. Characterize bacterial isolates by performing biochemical characters.
3. Assess the types of microorganisms present in air and soil.
4. Analyze bacteriological examination of water by appropriate tests.

Reference Books:

1. Nollert L. M. L. and De Gelder L. S. P. (2013). Handbook of Water Analysis. Third Edition. United States: Taylor and Francis. ISBN: ISBN 9781439889640
2. Atlas R. M. (2010). Handbook of Microbiological Media. Ukraine: Taylor and Francis
3. Patel R. (2009). Experimental Microbiology, Aditya Book Centre.
4. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India. ISBN: 9788121921534
5. WHO Guidelines for Indoor Air Quality: Dampness and Mould. (2009). Philippines: WHO.
6. Baker F. J. (1967) Bacteriological techniques. Butterworth & Co Publishers Ltd.

B.Sc.I SEMESTER – II

Open Elective (OE)

Course Title: Digital Marketing

Course I: BMiTOE 127 - Market promotion and Service Marketing

Course objectives:

Students should be able to ...

1. learn the importance of promotion mix.
2. know the concept of Integrated Marketing Communications.
3. study the challenge sin service marketing.
4. understand the five gap model in service marketing

Total Credits =2	SEMESTER– I OE Course – I BMiTOE 127 - Market Promotion and Service Marketing	No. of hours per unit
Unit - I	Marketing Promotion - A	08
	a) Meaning and Definition b) Elements of Promotion Mix c) Importance of Promotion Mix d) Factors Affecting Promotion Mix	
Unit – II	Marketing Promotion – B	08
	a) Integrated Marketing Communications (IMC) b) Scope of IMC c) Personal Selling, Procedure d) Skill Set for Effective Selling e) Global Trends in Selling	
Unit – III	Service Marketing - A	08
	a) Meaning, Definition & Features b) Importance of Service Marketing c) 7 P's of Service Marketing d) Challenges in Service Marketing	

Unit - IV	Service Marketing - B	06
	a) Scope of service sector b) Contemporary Issues in Service Marketing. c) Remedial measures to accelerate growth of Service Marketing d) Quality Management in Service Marketing – Five Gap Model in Service Marketing	

Course outcomes:

Students will be able to...

1. acquaint with the meaning and importance of marketing.
2. discuss the various concepts of marketing.
3. describe the process of market segmentation.
4. obtain an understanding of market targeting and market positioning.

Reference books:

1. Dr. K. Karunakaran (2013) Marketing management (text and cases in India context), Himalaya Publishing House- 3rd edition.
2. Roger Cox and Pual Brittain (2006) Retailing: an Introduction- Pearson Education Publishing, 15th edition.
3. Krishna K. Havaldar and Vasant m. Cavale, (2010) Sales and Distribution Management (text and cases), Mc Graw Hill Education Pvt. Ltd., 11th edition.
4. Indian Journal of Marketing, Satya Gilani on behalf of Associated Management Consultant Pvt. Ltd www.indianjournalofmarketing.com
5. Dr. K. Karunakaran , Services Marketing (Text & Cases in Indian Context), 2001
6. S. M. Jha , Service Marketing, Himalaya publishing house, 2019
7. Dr. V. N. Joshi, Service Marketing, Chandralok Prakashan, 2015
8. Steve Baran Kim Harris & Toni Hilton, Service Marketing Text & Cases, published by S. Baran, K. Cassidy & T. Hilton, 2009
9. Service Marketing People, Technology & Strategy , Published by Christopher Lovelock, 2001
<https://drive.google.com/file/d/1cG00Cvq0jYBuK6c97eSjnZ4a6-sy2vfY/view>

B.Sc.I SEMESTER – II**Open Elective (OE)****Course Title: Digital Marketing****Course I: BMiTOE 128 – Application of Digital Marketing****Course objectives:**

Students should be able to ...

1. understand the basic concept of search engine optimization.
2. know the different digital media applications.
3. study the display advertising.
4. learn the benefits of social media marketing

Total Credits 2	SEMESTER – II Course – II BMiTOE 128 – Application of Digital Marketing	No. of hours per unit
Unit - I	Search Engine Optimization	08
	a) Introduction of SEO b) Techniques of SEO c) Types of SEO d) Advantages of SEO e) Disadvantages of SEO	
Unit – II	Digital Media Applications	08
	a) Introduction b) Web design c) Blogs d) Web/Link Dictionaries e) Search Engine Marketing f) Video Marketing g) Email Marketing h) Other Application	

Unit – III	Display Advertising	08
	a) Introduction b) Web Banner Advertising c) Pop ups/ Pop down d) Expanding ad, Trick Banners, News Feed Ads, e) Adware, Affiliated Marketing f) Content Marketing	
Unit - IV	Social Media Marketing	06
	a) Fundamentals of Social Media Marketing and its Significance b) Different types of Ad formats c) Different Social Media Platforms d) Importance of Social Media Marketing e) Five Pillars of Social Media Marketing	

OUTCOMES

Students will be able to....

1. acquaint with the SEO.
2. discuss different digital media applications
3. understand display advertising
4. explain benefits of digital marketing.

References Books:

1. Abhishek Das., (2018) Application of Digital Marketing for success in business, BPB Publicatioion
2. Tracy L.Tuten, Michael R.Solomon- Social Media Marketing ,Sage Publication, New Delhi.
3. Harsh V.Verma, Services Marketing Text and Cases,Dorling kindersley(India pvt), 482 FIE, Patpargang, Delhi, 11009
4. Digital Marketing – kamat and Kamat- Himalaya
10. Digital Marketing- V. Ahuja, Oxford University Press
11. Digital marketing, S. Gupta, Mc Graw- Hill

B.Sc. I SEMESTER II

Skill Enhancement Course (SEC)

BMiTSEC 1: Fundamentals in Bioinformatics- I

Course objectives:

The students should be able to...

1. understand the different types of biological database.
2. study the bioinformatics resources for easy searching of biological database.
3. know the application of bioinformatics.
4. learn the concept of protein sequencing.

Credits=1	SEMESTER-II BMiTSEC 1-Fundamentals in Bioinformatics I	No. of hours per unit
UNIT I	Introduction to Bioinformatics	7
	Introduction to Bioinformatics: <ol style="list-style-type: none"> a. Definition and History of Bioinformatics, Internet and Bioinformatics, relationship between molecular evolution and bioinformatics. Structure-function relationship b. Basic data structure, Databases: Types of Databases Nucleotide sequence databases; protein sequencing 	
UNIT II	Bioinformatics Resources.	8
	<ol style="list-style-type: none"> a. Primary nucleotide sequence databases- EMBL, GenBank, DDBJ. Secondary nucleotide sequence databases- UniGENE, SGD, EMI Genom. b. Protein sequence database – SWISS PROT, TrEMBL, PIR, MIPS, NRL- 	

Course outcomes:

Student will be able to...

1. analyze different types of biological database.
2. use bioinformatics resources for easy searching of biological database.
3. apply the application of bioinformatics.
4. explain the concept of protein sequencing.

Reference Books:

1. Arthur L. (1988) Introduction to Bioinformatics Oxford University press.
2. Letovsky S. I. (1977) Bioinformatics: Databases and Systems.
3. Pevzner, (2002). Bioinformatics and functional genomics Wiley publication.
4. Rastogi S.C. (2013) Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery, 4 th edition, Phi publication.
5. Rajaraman V., (2001) Fundamentals of Computers, Phi Learning, ISBN:8120321758.
6. Tanenbaum Andrew S, (2003). Computer Networks, 4th Edition, Prentice Hall PTR, ISBN:8120321758.

B.Sc.I SEMESTER II

Practical Course I

Course objectives:

The students should be able to...

1. understand the concept of the internet.
2. learn genome sequencing technique.
3. study the different bioinformatics resources.
4. understand working of PCR.

Credits=1	SEMESTER-II Practical course I Practicals based on BMiT SEC 1	No. of hours (30)
	<ol style="list-style-type: none"> 1. Study of softwares for sequence analysis of nucleotides and proteins. 2. Demonstration of public domain databases for nucleic acid. 3. Demonstration of public domain databases for protein sequences 4. Introduction to genome sequencing technologies. 5. Demonstration of PCR 6. Demonstration of EMBL. 7. Exploring and assessing of resources NCBI/EBI/SIB 8. Demonstration of Uni GENE. 9. Exploring and assessing of biological information from GenBank/DDBJ. 10. Exploring biological information search engine Entrez. 	

Course outcomes:

The students will be able to...

1. describe the role of internet and its applications
2. demonstrate public domain databases for nucleic acid and protein sequences
3. explain the different bioinformatics resources.
4. operate PCR technique.

Reference Books:

1. Arthur L. (1988) Introduction to Bioinformatics Oxford University press
2. Letovsky Stanley I. (1977) Bioinformatics: Databases and Systems
3. Pevzner, (2002). Bioinformatics and functional genomics. Wiley publication.
4. Rastogi S.C. (2013) Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery, 4th edition, Phi publication.
5. Rajaraman V., (2001) Fundamentals of Computers, Phi Learning, ISBN:8120321758.
6. Tanenbaum Andrew S, (2003). Computer Networks, 4th Edition, Prentice Hall PTR, ISBN:8120321758.

**B.Sc.I Semester II
Value Education Course (VEC)**

Title of Course: Role of Values and Ethics in Microbiology

BMiT VEC-1

Course objectives:

Students should be able to...

1. Understand the universal human values.
2. Relate universal human values with Microbiology.
3. Know the importance of gender equity.
4. Correlate knowledge of cultural heritage with Microbiology.

Total Credits 2	SEMESTER – I BMiT - VEC-1 Role of Values and Ethics in Microbiology	No. of hours per unit
Unit - I	Universal Human Values	(08)
	a) Introduction to value education and need b) Self-Exploration, Understanding values in human-human relationship c) Harmony in the human being d) Meaning of Justice, Trust and Respect as the foundational values of relationship	
Unit – II	Ethical conduct and Ethical reasoning in Microbiology	(08)
	a) Ethical codes and guidelines in Microbiology. b) Recognizing ethical issue- In laboratory and publications of data c) Ethical Reasoning and Case Studies d) Consequences of unethical behavior- case studies	
Unit – III	Importance of gender equity in Microbiology	(08)
	a) Concept of gender, gender divide and gender equity b) Gender participation status and opportunities in Microbiology. c) Significance of gender equity in the development of Microbiology.	

	d) Case studies highlighting the direct and indirect achievements of females in Microbiology.	
Unit - IV	Importance of culture and heritage in the development of Microbiology	(06)
	a) Concept of culture and heritage b) Microbiology for cultural heritage in sustainable development. c) Applications of cultural and inherited knowledge in present day scenario of Microbiology. d) Cases in Microbiology according to the cultural history.	

Course outcomes:**Students will be able to...**

1. Describe the universal human values.
2. Explain concepts related to ethical values and ethical reasoning.
3. Create awareness about gender equity in academics.
4. Compare and analyze the importance of culture and heritage in development of microbiology.

Reference books:

1. Gaur R R, Asthana R, Bagaria G P (2019) "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi. ISBN 978-93- 87034-47-1
2. Tripathi N. (2004) "Human Values", New Age Intl. Publishers, New Delhi.
3. Rappert, B., and Jefferson, C. (2006). "The Development of the Dual Use Concept in the Life Sciences and Its Influence on International Policy." *Science and Public Policy*, 33(6), 475-486.
4. Desikan, P & Chakrabarti, Arunaloke and Muthuswamy, Vasantha. (2011). Ethical issues in microbiology. *Indian journal of medical microbiology*. 29. 327-30. 10.4103/0255-0857.90154.

