

## MODEL CURRICULUM

<b>Name of the Degree Program</b>	:	<b>BSc</b>
<b>(Basic/Hons.) Discipline Core</b>	:	<b>Microbiology</b>
<b>Total Credits for the Program</b>	:	<b>B.Sc. Basic - 136 and B.Sc. Hons. –176</b>
<b>Starting year of implementation</b>	:	<b>2021-22</b>

### **Program Outcomes:**

Competencies need to be acquired by the candidate securing B.Sc.(Basic) or B.Sc.(Hons)

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

1. Knowledge and understanding of concepts of microbiology and its application in **pharma, food, agriculture, beverages, nutraceutical industries.**
2. Understand the distribution, morphology and physiology of microorganisms and demonstrate the skills in aseptic handling of microbes including isolation, identification and maintenance.
3. Competent to apply the knowledge gained for conserving the environment and resolving the environmental related issues.
4. Learning and practicing professional skills in handling microbes and contaminants in laboratories and production sectors.
5. Exploring the microbial world and analyzing the specific benefits and challenges.
6. Applying the knowledge acquired to undertake studies and identify specific remedial measures for the challenges in health, agriculture, and food sectors.
7. Thorough knowledge and application of good laboratory and good manufacturing practices in microbial quality control.
8. Understanding biochemical and physiological aspects of microbes and developing broader perspective to identify innovative solutions for present and future challenges posed by microbes.
9. Understanding and application of microbial principles in forensic and working knowledge about clinical microbiology.
10. Demonstrate the ability to identify ethical issues related to recombinant DNA technology, GMOs, intellectual property rights, biosafety and biohazards.
11. Demonstrate the ability to identify key questions in microbiological research, optimize research methods, and analyze outcomes by adopting scientific methods, thereby improving the employability.
12. Enhance and demonstrate analytical skills and apply basic computational and statistical techniques in the field of microbiology.

**Assessment:****Weightage for assessments (in percentage)**

Type of Course	Formative Assessment /IA	Summative Assessment
Theory	40%	60%
Practical	40%	60%
Projects	40%	60%
Experiential Learning (Internships/MOO/Swayametc.)	40%	60%

**Curriculum Structure for the Undergraduate Degree Program  
BSc (Basic /Hons.)**

**Total Credits for the Program : 176**  
**Starting year of implementation : 2021-22**  
**Name of the Degree Program : B.Sc. (Basic/Hons.)**

**Microbiology Program Articulation Matrix:**

Se mes ter	Title /Name Of the course	Program outcomes that the course addresses (not more than 3per course)	Pre-requisi te course (s)	Pedagogy##	Assessment\$
1	DSC-1T MBL101 General Microbiology 4Credits 100Marks	1.Knowledge and Understanding of Concepts of microbiology. 2.Learningand practicing Professionals skills In handling microbes. 3.Thorough Knowledge and Application of Good laboratory And good manufacturing Practices in	PUC or +2 (Life Sciences as One of the core discipline s)	The general pedagogy to Be followed for theory And practicals are as under. Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counseling, Remedial Coaching. Field/Institution/Indust rial visits, Hands on training, Case observations, Models/charts preparations, Problem Solving mechanism, Demonstrations, Project	LSSSDC (NSDC) assessment and certification For lab Technician or Lab assistant Job role

		Microbial quality control.		presentations, Experiential Documentation and Innovative methods.	
	DSC-1P MBL101 General Microbiology 2Credits 50Marks				
2	DSC-2T MBL102 Microbial Biochemistry and Physiology 4Credits 100Marks	Thorough knowledge and understanding of concepts of microbiology and its application in different microbiological industries.		The general pedagogy to be followed for theory and practicals are as under. Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counseling, Remedial Coaching. Field/Institution/Industrial	LSSSDC(NSDC) Assessment and certification for lab technician or Lab assistant job role
				visits, Hands on training, Case observations, Models/charts preparations, Problem solving mechanism, Demonstrations, Project presentations, Experiential documentation and Innovative methods.	
	DSC-2P MBL102 Microbial Biochemistry and Physiology 2Credits 50Marks				
3	DSC-3T MBL103 Microbial diversity 4Credits 100Marks				
	DSC-3P				

	MBL103 Microbial diversity 2Credits 50Marks				
4	DSC-4T MBL104 Microbial Enzymology and Metabolism 4Credits 100Marks				
	DSC-4P MBL104 Microbial Enzymology and Metabolism 2Credits 50Marks				
5	DSC-5T MBL105 Microbial Genetics and Molecular biology 3Credits 100Marks				
	DSC-5P MBL105 Microbial Genetics and Molecular biology 2Credits 50Marks				
	DSC-6T MBL106 Immunology and Medical microbiology 3Credits 100Marks				
	DSC-6P MBL106 Immunology				

	and Medical microbiology 2Credits 50Marks				
6	DSC - 7TM BL1 07 Food and Dairy Microbiol ogy 3Credits 100Marks				
	DSC- 7PMBL107 Food and Dairy Microbiolog y 2Credits 50Marks				
	DSC- 8TMBL108 Industrial Microbiolog y and Bioprocess Technology 3Credits 100Marks				
	DSC- 8PMBL108 Industrial Microbiolog y and Bioprocess Technology 2Credits 50Marks				
	DSC- 9TMBL109 Microbial Genetic Engineering 3Credits 100Marks				

7	DSC-9PMBL109 Microbial Genetic Engineering 2Credits 50Marks				
	DSC-10TMBL110 Environmental and Agricultural Microbiology 3Credits 100Marks				
	DSC-10PMBL110 Environmental and Agricultural Microbiology 2Credits 50Marks				
	DSC-11TMBL111 Pharmaceutical and Forensic Microbiology 4Credits 100Marks				
8	DSC-12TMBL 112 Biosafety, Bioetics&IRP 4Credits 100Marks				
	DSC-13TMBL 113 Genomics, Proteomics and Metabolomics 4Credits 100Marks				

	DSC-14T MBL 114 Aquatic Microbiology 3Credits 100Marks				
	DSC-15T MBL 115 Microbial Genetic Engineering 3Credits 100Marks				
9	DSC-15P MBL 115 Microbial Genetic Engineering 2Credits 50Marks				
	DSC-16T MBL 116 Environmental and Agricultural				
	Microbiolo gy 3 Credits 100Marks				
	DSC- 16PMBL116 Environment alandAgricul turalMicrobi ology2 Credits 50Marks				

	DSC-17TMBL117 Pharmaceutic aland ForensicMier obiology 4Credits 100Marks				
	DSC-18TMBL118 Emerging MicrobialT echnologie s 4 Credits 100Marks				
<b>10</b>	DSC-19TMBL119 Extremophy lic Microbes andExtremo lytes 4 Credits 100Marks				
	DSC-20TMBL120 Molecular Diagnosis, Drug Designing and Advanced Vaccines 3 Credits 100Marks				

**# Note:**

##Pedagogy for student engagement is predominantly lectures. However, other pedagogies enhancing better student engagement to be recommended for each course. The list includes active learning/ course projects/ problem or project based learning/ case studies/self-study like seminar, term paper or MOOC.

\$ Every course needs to include assessment for higher order thinking skills (Applying/ Analyzing/Evaluating/Creating).However, this column may contain alternate assessment methods that help formative assessment (i.e. assessment for learning).



**B. Sc., Microbiology (Basic / Hons.) Semester 1**

<b>Course Title: DSC-1T, MBL101, General Microbiology</b>	
Total Contact Hours: <b>56</b>	Course Credits: <b>4+2</b>
Formative Assessment Marks: <b>40%</b>	Duration of ESA/Exam: <b>3Hrs</b>
Model Syllabus Authors: <b>Curriculum Committee</b>	Summative Assessment Marks: <b>60%</b>

**Course Pre-requisite(s):** *Mention only course titles from the curriculum that are needed to be taken by the students before registering for this course.*

**Course Outcomes (COs):**

At the end of the course the student should be able to:

*(Write 3-7 course outcomes. Course outcomes are statements of observable student actions that serve as evidence of knowledge, skills and value acquired in this course)*

- 1. Thorough knowledge and understanding of concepts of microbiology.**
- 2. Learning and practicing professional skills in handling microbes.**
- 3. Thorough knowledge and application of good laboratory and good manufacturing practices in microbial quality control.**

**Course Articulation Matrix:** Mapping of Course Outcomes (COs) with Program Outcomes (POs1-12)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12
1. Thorough knowledge and understanding of concepts of microbiology	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>								
2. Learning and practicing professional skills in handling microbes		<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>					
3. Thorough knowledge and application of good laboratory and good manufacturing practices in microbial quality control.		<input type="checkbox"/>		<input type="checkbox"/>			<input type="checkbox"/>					

Course Articulation Matrix relates course outcomes of course with the corresponding program outcomes whose attainment is attempted in this course. Mark 'X' in the intersection cell if a course outcome addresses a particular program outcome.

## B.Sc., Microbiology (Basic/ Hons.)Semester 1

### Title of the Courses:

**Course1:DSC-1T,MBL101,General Microbiology**

**Course2:OE1T,MBL301, Microorganisms for Human Welfare**

**Course3:SEC1T,MBL701,Microbiological Methods and Analytical Techniques**

Course1:DSC-1T, MBL101, <b>General Microbiology</b>		Course 2: OE1T,MBL301, <b>Microorganisms for Human Welfare</b>		Course 3: SEC1T,MBL701, <b>Microbiological Methods and Analytical Techniques</b>	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
<b>4</b>	<b>56</b>	<b>3</b>	<b>42</b>	<b>1</b>	<b>14</b>

<b>ContentofCourse1:Theory:DSC-1T,MBL101,General Microbiology</b>	<b>56Hrs</b>
<b>Unit – 1:Historical development of microbiology</b>	14Hrs
<p>Historical development of microbiology-Theory of spontaneous generation, Biogenesis and Abiogenesis. Contributions of AntonVon Leeuwenhoek, Louis Pasteur, Robert Koch,Joseph Lister and Edward Jenner, Alexander Fleming, Martinus Beijerinck, Segei Winogradsky, Elei Metchnikoff. Contributions of Indian scientists in the field of Microbiology. Scope of Microbiology.</p> <p>Fossil evidences of microorganisms. Origin of life, primitive cells and evolution of microorganisms.</p> <p>Microcopy- working principle, construction and operation of simple and compound microscopes.</p>	
<b>Unit –2:Staining,sterilization and preservation of microorganisms</b>	14Hrs
<p>Staining: Nature of strains, principles, mechanism, methods and types of staining-Simple, Differential-Gram staining, Acid fast staining, staining of capsule, cell wall,endospore.</p> <p>Sterilization: Principles, types and techniques, Physical, chemical, radiation and mechanical.</p> <p>Preservation of microorganisms: Definition, importance, methods of preservation of microorganism –slant culture, stab culture, soil culture, mineral oil overlaying, glycerol preservation, lyophilization, cryopreservation.</p>	

<b>Unit–3:Prokaryotic microorganisms:</b>	14Hrs
Overview of prokaryotic cell structure: Size, shape, arrangement. Ultra structure of prokaryotic cell: Bacterial and Archaeal-cell wall and cell membrane. Components external to cell wall- capsule, slime, s-layer, pili, fimbriae, flagella; structure, motility, chemotaxis. Cytoplasmic matrix- Cytoskeleton, ribosome, inclusion granules: Composition and function. Nuclear Materials – Bacterial structure (its differences with the Eukaryotic chromosome); Extra Chromosomal material. Bacterial Endospore - Examples of spore forming organisms, habitats, function, formation and germination. Reproduction in bacteria.	
<b>Unit–4:Eukaryotic microorganisms</b>	14Hrs
Overview of eukaryotic cell: Types of cells; Structure and function of organelles- Cell wall, cell membrane, cytoplasmic matrix, cytoskeleton, endoplasmic reticulum, golgi complex, peroxisomes, lysosomes, vesicles, ribosomes, mitochondria chloroplast and nucleus. Structure and functions of flagella. Reproduction in eukaryotes: A brief account of vegetative, asexual and sexual methods of reproduction	

**Course1:Practical: DSC-1P,MBL101,General Microbiology**

1. Microbiological laboratory standards and safety protocols.
2. Operation and working principles of Light/Compound microscope.
3. Working principles and operations of basic equipments of microbiological laboratory (Laminar Air Flow Chamber, Autoclave, Hot air Oven, Incubator, pH meter, Spectrophotometer, Colorimeter, vortex, magnetic stirrer etc).
4. Demonstration and observations of microorganisms from natural sources under light microscope (Algae, Yeast and Protozoa).
5. Study of bacterial motility by hanging drop method.
6. Simple staining and negative staining technique
7. Differential staining- Gram staining.
8. Acid fast staining.
9. Structural staining - Flagella and capsule.
10. Bacterial endospore staining.
11. Staining of reserved food materials (granular).
12. Staining of fungi by lactophenol cotton blue.

### **Suggested Readings:**

1. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.
2. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2002. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869 pp.
3. Atlas, R.M. 1984. Basic and practical microbiology. Mac Millan Publishers, USA. 987pp.
4. Black, J.G. 2008. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 846 pp.
5. Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark-12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
6. Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGraw Hill.
7. General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillan education limited.
8. Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed. 2008, Pearson Education.
9. Microbiology- Concepts and Applications, PelczarJr,Chan, Krieg, International ed, McGraw Hill.
10. Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones and Bartlett
11. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Pub.Sudbury, 835 pp.
12. Schlegel, H.G. 1995.General Microbiology. Cambridge University Press, Cambridge, 655 pp.
13. Tortora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9<sup>th</sup> ed. Pearson Education Pte. Ltd., San Francisco. 958pp. Woolverton, 7th International, edition 2008, McGraw Hill.

**Course2:Theory: OE1T, MBL301, Microorganisms for Human Welfare**

<b>Course2:OE1T,MBL 301,Microorganisms for Human Welfare</b>	<b>42Hrs</b>
<b>Unit–1:Food and Fermentation Technology</b>	<b>14Hrs</b>
Fermented Foods–Types, Nutritional Values, Advantages and Health Benefits Prebiotics, Probiotics, Synbiotics and Nutraceuticals Fermented Products: Alcoholic-Beer and whisky; nonalcoholic beverages-coffee and tea; fermented dairy products-yoghurt and cheese; fermented fruit drinks-wine	
<b>Unit–2:Agriculture</b>	<b>14Hrs</b>
Bio-fertilizers and bio-pesticides - types and applications, beneficial microorganisms in agriculture, AM fungi, Mushroom cultivation, Biogas production.	
<b>Unit –3:Biopharmaceuticals</b>	<b>14Hrs</b>
Microbial Drugs–Introduction, Discovery, Antibiotics –Definition, characteristics, Types, Functions. Antibiotic Therapy and Development of Drug Resistance Vaccines–Types, Properties, Functions and Schedules	

**Course 3: Theory: SEC 1T, MBL 701, Microbiological Methods and Analytical Techniques****LEARNING OUTCOMES**

- Demonstrate skills as per National Occupational Standards(NOS) of “Lab Technician/Assistant” Qualification Pack issued by Life Sciences Sector Skill Development Council-LFS/Q0509,Level3.
  - Perform microbiology and analytical techniques. Knowledge about environment ,health, and safety (EHS), good laboratory practices (GLP), good manufacturing practices (GMP) and standard operating procedures(SOP)
  - Demonstrate professional skills at work, such as decision making, planning, and organizing, Problem solving, analytical thinking ,critical thinking, and documentation.
1. Principles which underlies sterilization of culture media, glassware and plastic ware to be used for microbiological work.
  2. Principles of a number of analytical instruments which the students have to useduringthestudyandalsolaterasmicrobiologistsforperformingvariouslaboratorymanipulations.
  3. Handling and use of microscopes for the study of microorganisms which are among the basic skills expected from a practicing microbiologist. They also get introduced to a variety of modifications in the microscopes for specialized viewing.
  4. Several separation techniques which may be required to be handled later as microbiologists.

**Course 3:Theory: SEC 1T,MBL701,  
Microbiological Methods and Analytical Techniques**

SEC1T,MBL701,Microbiological Methods and Analytical Techniques	14Hrs
<p><b>DIGITALSKILLS:</b> The components of digital skills provided by KSHEC, will be followed accordingly.</p> <p><b>Microbiological Skills</b> Microbiological culture media: Composition, Preparation, Application and storage; Ingredients of media. Types- natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media.</p> <p>Isolation and cultivation of microorganisms: Collection of samples, processing of samples, serial dilution, technique, Inoculation of samples, incubation and observations of microbial colonies.</p> <p>Morphological characterization of microorganisms-Colony characteristics, Microscopic characters, biochemical / physiological tests or properties and identification.</p> <p>Sub-culturing of microorganisms and pure culture techniques. Preservation of microorganisms.</p> <p>Advanced Microscopic Skills: Different types of microscopes - Phase contrast,BrightField,DarkField,Fluorescent,ScanningandTransmissionElectron Microscopy</p> <p><b>Analytical Skills</b> Centrifugation, Chromatography and Spectroscopy, Electrophoresis: Principles, Types, Instrumentation, Operation and applications.</p>	

**Course 3: Practicals: SEC 1P, MBL 701, Microbiological Methods and Analytical Techniques**

1. Methods and practices in Microbiology lab: MSDS (Material Safety and Data Sheet),Good Clinical Practices (GCP),Standard Operating Procedure(SOP),Good Laboratory Practices(GLP),Good Manufacturing Practices (GMP).
2. Usage and maintenance of basic equipments of microbiology lab: Principles, calibrations, and SOPs of balances, pH meter, autoclave, incubators, laminar air flow (LAF) and biosafety cabinets, microscopes, homogenizers,s tirrers.
3. Preparation of bacterial culture media
4. Preparation of fungal culture media
5. Preparation of algal culture media
6. Isolation and cultivation of bacteria, actinobacteria, fungi and algae
7. Identification and characterization of bacteria, actinobacteria, fungi and algae.
8. Biochemical and physiological tests for identification of bacteria
9. Separation of biomolecules by paper / thin layer chromatography.
10. Demonstration of column chromatography.
11. Preparation of permanent slides (bacteria, fungi and algae).
12. Procedures for documentation, lab maintenance, repair reporting.

**Pedagogy:**

The general pedagogy to be followed for theory and practicals are as under. Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counseling, Remedial Coaching. Field/Institution/Industrial visits, Hands on training, Case observations, Models/charts preparations, Problem solving mechanism, Demonstrations, Project presentations, Experiential documentation and Innovative methods.

Active learning as per LSSSDC (NSDC) LFS/Q0509 guidelines, at skill training Level 3. Case studies about application of microbial biomolecules in various industries. Seminar on topics of microbial biochemistry.

<b>Formative Assessment: 40%</b>	
<b>Assessment Occasion/type</b>	<b>Weightage in Marks</b>
IA(2 Tests)	20%:20 Marks
Assignments/Visits	10%:10 Marks
Seminars/Group Discussion	10%:10 Marks
<b>Total</b>	<b>40%:40 Marks</b>

**Date**  
**14.09.2021**

**Course Co-ordinator**  
**Special Officer, KSHEC**  
**(Dr. Prasanna Kumar)**

**Subject Committee Chairperson**  
**Vice Chancellor, Gulbarga University**  
**(Prof. Dayanand Agsar)**

**B. Sc., Microbiology (Basic / Hons.) Semester 2**

**Title of the Courses:**

**Course 1: DSC-2T, MBL 102, Microbial Biochemistry and Physiology**

**Course2: OE-2T, MBL302, Environmental Microbiology and Human Health**

<b>Course1: DSC-2T, MBL102, Microbial Biochemistry and Physiology</b>		<b>Course 2: OE-2T, MBL 302, Environmental Microbiology and Human Health</b>	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
<b>4</b>	<b>56</b>	<b>3</b>	<b>42</b>

<b>Content of Course: DSC-2T, MBL102, Microbial Biochemistry and Physiology</b>	<b>56Hrs</b>
<b>Unit-1 Biochemical Concepts</b>	14Hrs
Basic Biochemical Concepts: Major elements of life and their primary characteristics, atomic bonds and molecules – bonding properties of carbon, chemical bonds- covalent and non covalent, Hydrogen bonds and Vander Waal Forces. Biological Solvents: Structure and properties of water molecule, Water as an universal solvent, polarity, hydrophilic and hydrophobic interactions, properties of water, Acids, bases, electrolytes, hydrogen ion concentration, pH, buffers and physiological buffer system, Handerson–Hasselbatch equation.	
<b>Unit- 2 Macromolecules</b>	14Hrs
Carbohydrates: Definition, classification, structure and properties. Amino acids and proteins: Definition, structure, classification and properties Lipids and Fats: Definition, classification, structure, properties and importance of lipids; fatty acids: types and classification, Vitamins, Definition, structure, properties and importance of chlorophyll, cytochromes and hemoglobin.	
<b>Unit–3 Microbial growth and nutrition</b>	14Hrs
Microbial Growth: Definition of growth, Growth curve, phases of growth, Influence of environmental factors on growth, generation time and specific growth rate. Synchronous growth, Continuous growth (chemostat and turbidostat), Diauxic growth.	



<p>Measurement of Growth: Direct Microscopic count - Haemocytometer; Viable count, Membrane filtration; Electronic Coulter Counting method; Measurement of cell mass; Turbidity measurements- Nephelometer and spectrophotometer techniques. Growth Yield (definition of terms).</p> <p>Microbial Nutrition: Microbial nutrients, macro and micronutrients, classification of organisms based on nutritional requirements.</p> <p>Membrane Transport: Structure and organization of biological membranes, Types of cellular transport - passive, facilitated, active, group translocation, membrane bound protein transport system, carrier models, liposomes, ion channels, Na<sup>+</sup>K<sup>+</sup>-ATPase.</p>	
<p><b>Unit-4: Bioenergetics, Respiration and Photosynthesis</b></p>	14Hrs
<p>Bioenergetics: Free energy, Enthalpy, Entropy, Classification of high energy compounds, Oxidation reduction reactions, equilibrium constant, Redox potential, Laws of thermodynamics, Energy coupling reactions, Exothermic and Endothermic reactions.</p> <p>Respiration: Glycolysis, TCA cycle and electron transport chain, oxidative and substrate level phosphorylation. Anaerobic respiration, Fermentation( homo and heterolactic fermentation)</p> <p>Microbial Photosynthesis: Photosynthetic pigments in prokaryotes. Types of Bacterial photosynthesis- Oxygenic and Anoxygenic: Photophosphorylation- Cyclic and Non- cyclic Light reaction, Dark Reaction (CO<sub>2</sub> fixation pathways)- Calvincycle.</p>	

**Course 1: Practicals: DSC-2P, MBL 102, Microbial Biochemistry and Physiology**

1. Preparation of normal and molar solutions
2. Calibration of pH meter and determination of pH of natural samples
3. Preparation of buffer solutions (any 4)
4. Qualitative analysis of carbohydrates
5. Qualitative analysis of amino acids and proteins
6. Qualitative analysis of lipids
7. Estimation of reducing sugars by DNS method
8. Estimation of protein by Lowry's/Biuret method
9. Determination of saponification values and iodine number of lipids/fatty acids
10. Determination of bacterial growth by turbidometric method
11. Effect of pH, temperature and salt concentration on bacterial growth
12. Demonstration of aerobic and anaerobic respiration in microbes

### Text Books/References

1. Boyer R. (2002), Concepts in Biochemistry 2<sup>nd</sup> Edition, Brook/Cole, Australia.
2. Caldwell, D.R. (1995) – Microbial Physiology and Metabolism. Brown Publishers.
3. Felix Franks, 1993; Protein Biotechnology, Humana Press, New Jersey.
4. Harper, 1999; Biochemistry, McGraw Hill, New York.
5. Lodish H, T. Baltimore, A. Berck B.L. Zipursky, P. Mastysdaire and J. Darnell. (2004) –
6. Moat A. G., Foster J.W. Spector. (2004), Microbial Physiology 4<sup>th</sup> Edition Panama Book Distributors.  
Molecular Cell Biology, Scientific American Books, Inc. New York.
7. Nelson and Cox, 2000; Lehninger Principles of Biochemistry, Elsevier Publ.
8. Palmer T. (2001), Biochemistry, Biotechnology and Clinical Chemistry, Harwood Publication, Chichester.
9. Stryer L, 1995; Biochemistry, Freeman and Company, New York.
10. Voet & Voet, 1995; Biochemistry, John Wiley and Sons, New York.

### Course 2: Theory: OE- 2T, MBL 302, Environmental Microbiology and Human Health

<b>Course 2 :Theory: OE- 2T, MBL 302, Environmental Microbiology and Human Health</b>	<b>42Hrs</b>
<b>Unit–1: Soil and Air Microbiology</b>	<b>14 Hrs</b>
Soil and Air as a major component of environment. Types and properties of soil. Distribution of microorganisms in soil and air. Major types of beneficial and harmful microorganisms in soil and air.	
<b>Unit –2: Water Microbiology</b>	<b>14 Hrs</b>
Water as a major component of environment. Types and uses of water. Microorganisms in different water bodies. Standard qualities and analysis of drinking water	
<b>Unit –3: Microbial Diseases and Control</b>	<b>14 Hrs</b>
Public health hygiene and communicable diseases. General Account of Microbial infections - Airborne, water borne and Food borne- Source, Mode of Transmission, Symptoms, Prevention and control. Surveillance of microbial infections.	

### Text Books/References

1. A Textbook of Microbiology, R.C. Dubey and D.K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.
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9. Microbiology – Concepts and Applications, Pelczar Jr, Chan, Krieg, International ed, McGraw Hill.
10. Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones and Bartlett
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12. Schlegel, H.G. 1995. General Microbiology. Cambridge University Press Cambridge, 655 pp.
13. Tortora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9th ed. Pearson Education Pvt. Ltd., San Francisco. 958 pp.

### Pedagogy:

The general pedagogy to be followed for theory and practicals are as under.

Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counseling, Remedial Coaching, Field/Institution/Industrial visits, Hands on training, Case observations, Models/charts preparations, Problem solving mechanism, Demonstrations, Project presentations, Experimental documentation and Innovative methods.

<b>Formative Assessment: 40%</b>	
<b>Assessment Occasion/type</b>	<b>Weightage in Marks</b>
IA (2 Tests)	20% : 20 Marks
Assignments/Visits	10% : 10 Marks
Seminars / Group Discussion	10% : 10 Marks
<b>Total</b>	<b>40% : 40 Marks</b>

**Date**

**14.09.2021**

**Course Co-ordinator**

**Special Officer, KSHEC  
(Dr. Prasanna kumar)**

**Subject Committee Chairperson**

**Vice Chancellor, Gulbarga University  
(Prof. Dayanand Agsar)**