



KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ



Tele: 0836-2215224
e-mail: academic.st@kud.ac.in
Pavate Nagar, Dharwad-580003
ಪಾವಟೆ ನಗರ, ಧಾರವಾಡ - 580003

NAAC Accredited
'A' Grade 2014

website: kud.ac.in

No.KU/Aca(S&T)/RPH-394A/2021-22/ 954

Date: 30 SEP 2021

ಅಧಿಸೂಚನೆ

ವಿಷಯ: 2021-22ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಎಲ್ಲ ಸ್ನಾತಕ ಕೋರ್ಸುಗಳಿಗೆ 1 ಮತ್ತು 2ನೇ ಸೆಮೆಸ್ಟರ್
NEP-2020 ಮಾದರಿಯ ಪಠ್ಯಕ್ರಮವನ್ನು ಅಳವಡಿಸಿರುವ ಕುರಿತು.

- ಉಲ್ಲೇಖ: 1. ಸರ್ಕಾರದ ಅಧೀನ ಕಾರ್ಯದರ್ಶಿಗಳು(ವಿಶ್ವವಿದ್ಯಾಲಯ 1) ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ ಇವರ
ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 260 ಯುಎನ್ಇ 2019(ಭಾಗ-1), ದಿ:7.8.2021.
2. ವಿಶೇಷ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ ದಿನಾಂಕ: 19.08.2021
3. ಈ ಕಚೇರಿ ಸುತ್ತೋಲೆ ಸಂ.No. KU/Aca(S&T)/RPH-394A/2021-22/18 ದಿ:21.08.2021.
4. ಸರ್ಕಾರಿ ಆದೇಶ ಸಂಖ್ಯೆ ಇಡಿ 260 ಯುಎನ್ಇ 2019(ಭಾಗ-1), ಬೆಂಗಳೂರು
ದಿನಾಂಕ: 15.9.2021.
5. ಎಲ್ಲ ಅಭ್ಯಾಸಸೂಚಿ ಮಂಡಳಿ ಸಭೆಗಳ ನಡವಳಿಗಳು
6. ಎಲ್ಲ ನಿಖಾಯಗಳ ಸಭೆಗಳು ಜರುಗಿದ ದಿನಾಂಕ: 24,25-09-2021.
7. ವಿಶೇಷ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ ಸಂಖ್ಯೆ: 01 ದಿನಾಂಕ: 28.9.2021.
8. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಆದೇಶ ದಿನಾಂಕ: 30.09.2021

ಮೇಲ್ಕಾಣಿಸಿದ ವಿಷಯ ಹಾಗೂ ಉಲ್ಲೇಖಗಳನ್ವಯ ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಆದೇಶದ ಮೇರೆಗೆ, 2021-22ನೇ
ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ, ಎಲ್ಲ B.A./ BPA (Music)/BVA/ BTM/ BSW/ B.Sc./B.Sc. Pulp & Paper
Science/ B.Sc. (H.M)/ BCA/ B.A.S.L.P./ B.Com/ B.Com (CS)/ & BBA ಸ್ನಾತಕ ಕೋರ್ಸುಗಳ 1 ಮತ್ತು 2ನೇ
ಸೆಮೆಸ್ಟರ್‌ಗಳಿಗೆ NEP-2020 ರಂತೆ ವಿಶೇಷ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಅನುಮೋದಿತ ಕೋರ್ಸಿನ ಪಠ್ಯಕ್ರಮಗಳನ್ನು
ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ www.kud.ac.in ದಲ್ಲಿ ಭಿತ್ತರಿಸಲಾಗಿದೆ. ಸದರ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲದಿಂದ
ಡೌನ್‌ಲೋಡ್ ಮಾಡಿಕೊಳ್ಳಲು ಸೂಚಿಸುತ್ತ ವಿದ್ಯಾರ್ಥಿಗಳ ಹಾಗೂ ಸಂಬಂಧಿಸಿದ ಎಲ್ಲ ಬೋಧಕರ ಗಮನಕ್ಕೆ ತಂದು ಅದರಂತೆ
ಕಾರ್ಯಪ್ರವೃತ್ತರಾಗಲು ಕವಿವಿ ಅಧೀನದ/ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ ಸೂಚಿಸಲಾಗಿದೆ.

ಅಡಕ: ಮೇಲಿನಂತೆ

(Handwritten Signature)
(ಡಾ. ಹನುಮಂತಪ್ಪ ಕೆ.ಟಿ.)
ಕುಲಸಚಿವರು.

ಗೆ,

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ
ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ. (ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ ಹಾಗೂ ಮಿಂಚಂಚೆ ಮೂಲಕ ಬಿತ್ತರಿಸಲಾಗುವುದು)

ಪ್ರತಿ:

1. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
2. ಕುಲಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
3. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
4. ಅಧೀಕ್ಷಕರು, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ / ಗೌಪ್ಯ / ಜಿ.ಎ.ಡಿ. / ವಿದ್ಯಾಂಡಳ (ಪಿ.ಜಿ.ಪಿ.ಎಚ್.ಡಿ) ವಿಭಾಗ, ಸಂಬಂಧಿಸಿದ
ಕೋರ್ಸುಗಳ ವಿಭಾಗಗಳು ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
5. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ / ವಿದ್ಯಾರ್ಥಿ ಕಲ್ಯಾಣ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.



KARNATAK UNIVERSITY, DHARWAD

4-Year B.Sc. (Hons.) Program

SYLLABUS

Microbiology

[Effective from 2021-22]

DISCIPLINE SPECIFIC CORE COURSE (DSCC) FOR SEM I & II,

OPEN ELECTIVE COURSE (OEC) FOR SEM I & II and

SKILL ENHANCEMENT COURSE (SEC) FOR SEM I

AS PER N E P - 2020

Karnatak University, Dharwad
Four Years Under Graduate Program in Microbiology for B.Sc. (Hons.)
Effective from 2021-22

Sem	Type of Course	Theory/ Practical	Instruction hour per week	Total hours of Syllabus / Sem	Duration of Exam	Internal Assessment Marks	Sem End Exam. Marks	Total Marks	Credits
I	DSCC-1T	Theory	04 hrs	56	03 hrs	30	70	100	04
	DSCC-1P	Practical	04 hrs	52	03 hrs	15	35	50	02
	OEC-1	Theory	03 hrs	42	03 hrs	30	70	100	03
	*SEC-1	Practical	02 hrs	22-30	03 hrs	15	35	50	02
II	DSCC-2T	Theory	04 hrs	56	03 hrs	30	70	100	04
	DSCC-2P	Practical	04 hrs	52	03 hrs	15	35	50	02
	OEC-2	Theory	03 hrs	42	03 hrs	30	70	100	03
Details of the other Semesters will be given later									

***Student can opt digital fluency as SEC or the SEC of his/ her any one DSCC selected it will be evaluated as pr the guidelines issued by the University time to time.**

Preamble

The Government of India identified Microbiology as a thrust area for development in the field of life science. It has a well-defined objective of establishing several centres of excellence, conducting research and promoting academic institutions focusing on Microbiology-based programmes. In addition, Universities have also been a congenial environment with the knowledge of Microbiology.

The main objective of a B.Sc. (Honours) programme in Higher Education system is to prepare the students for the society. The Microbiology involves understanding how microorganisms' function at the molecular and cellular level. It combines several disciplines including biology, physics chemistry, mathematics, science, and technology, with special emphasis on genetics, biochemistry, molecular biology, immunology, bioprocess engineering, etc.. New technologies and products are developed every year within the areas of medicine, agriculture, food and dairy, environmental and Bio based industry. There are varieties of methods to achieve transformation including those associated with biological vectors and physical methods of introduction through direct exposure of cells or protoplasts to DNA and the acceleration of small DNA-coated projectiles into plant, animal or microbial cells.

Microbiology is a science – driven industry sector that uses microorganisms and molecular biology to produce healthcare-related products. The program in Microbiology will offer a wonderful opportunity to students with an ability to gain specialization while customizing and individualizing the education for desired skills and careers in food and dairy microbiology, Industrial Microbiology, Fermentation Technology, Environmental Microbiology, Medical Microbiology, and Research methodology. Students are made aware of the economic impact and are supported in creating significant workforce opportunities in Microbiology as entrepreneurs or as employees in major sectors such as therapeutics, drugs, pharmaceuticals, food and dairy technologies, industries and research, testing, and medical labs. Microbiology integrates medical science, research, manufacturing, and Microbiology-based business skills with leadership, teamwork and entrepreneurship skills that are essential for career success in the Microbiology field.

Model Curriculum

Name of the Degree Program: **BSc (Basic / Hons.)**

Discipline Core: **MICROBIOLOGY**

Total Credits for the Program: 188

Starting year of implementation: 2021-22

Program Outcomes (PO):

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

1. Gain Knowledge and understanding of concepts of microbiology and its application in **pharma, food, agriculture, beverages, nutraceutical industries**. Knowledge on history, general characters and classification of Microorganisms, Viz- Bacteria, Fungi, algae, protozoa and virus. Understanding the microbiological techniques, cultivation and detection of microorganisms. Comprehend evolutionary importance and economic significance of microorganisms and microbiology. Understand the distribution, morphology and physiology of microorganisms and demonstrate the skills in aseptic handling of microbes including isolation, identification and maintenance.
2. To develop understanding about Biochemistry, enzymes, microbial metabolism, growth and bioenergetics. Students will become efficient in managerial skills, able to employ analytical reasoning, problems solving and interpretation and documentation of laboratory experiments at a level suitable to succeed at an entry-level position in Microbiology.
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.

Curriculum Structure for the Undergraduate Degree Program

BSc Microbiology

Total Credits for the Program: 188

Starting year of implementation: 2021-22

Name of the Degree Program: BSc

Discipline/Subject: Microbiology

Program Articulation Matrix:

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project, internships etc. Elective courses may be listed separately

Semester	Title /Name Of the course	Program outcomes that the course addresses (not more than 3 per course)	Pre-requisite course (s)	Pedagogy	Assesment
1	DSC-1T MBL 101 General Microbiology 4 Credits 100 Marks	1. 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.	PUC or +2 (Life sciences as one of the core disciplines)	The general pedagogy to be followed for theory and practicals are as under. Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counselling, 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.	LSSSDC (NSDC) assessment and certification for lab technician or Lab assistant or other significant jobs.
	DSC-1P MBL 101 General Microbiology 2 Credits 50 Marks				
2	DSC-2T MBL 102 Microbial Biochemistry	Thorough knowledge and understanding of concepts of Biochemistry, microbial		The general pedagogy to be followed for theory and practicals are as	LSSSDC (NSDC) assessment and certification for lab technician or Lab assistant or other significant jobs

	and Physiology 4 Credits 100 Marks	physiology and its application in different microbiological industries.		under. Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counseling, Remedial Coaching. Field/Institution/I ndustries	role
	DSC-2P MBL 102 Microbial Biochemistry and Physiology 2 Credits 50 Marks				
3	DSC- 3T Microbial Diversity				
4	DSC-4T Microbial physiology and Metabolism				
5.	DSC- 5 T Microbial Genetics and Molecular Biology				
	DSC – 6T Immunology and Medical Microbiology				
6.	DSC – 7T Food and Dairy Microbiology				
	DSC – 8T Microbial Genetic Engineering				
7.	DSC – 9T Environmental and Agricultural Microbiology	PO5,PO7,PO8		Project based learning,	Class work Seminar

	DSC – 10T Industrial Microbiology and Bioprocess Technology	PO5,PO7,PO8		Term paper Assignme nt,	Project writing
	DSC – 11T Pharmaceutical and Forensic Microbiology	PO5,PO7		Group Discussi on	Articles writing,
8.	DSC – 12T Biosafety, Bioethics and IPR	PO6,PO7,PO8		Resear ch Project	
	DSC – 13T Multiomics	PO6,PO7,PO8		Instrumentatio n	
	DSC – 14T Aquatic Microbiology	PO6,PO7,PO8			

Pedagogy

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

Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counselling, 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.

\$ 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).

BSc Semester 1

Course Title: MICROBIOLOGY	
Total Contact Hours:56	Course Credits: T-4,P-2, TOTAL: 6
Formative Assessment Marks:IA-30	Duration of ESA/Exam: 3hrs
Summative AssessmentMarks:70	

Course Pre-requisite(s):

PUC or +2 (Life sciences as one of the core disciplines)

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 values acquired in this course)

PO1: At the end of the course the student will have broad and balanced knowledge of Microbiology, history, general characters and classification of Microorganisms, Viz-Bacteria, Fungi, algae, protozoa and virus, Understanding the microbiological techniques, cultivation and detection of microorganisms. Comprehend evolutionary importance and economic significance of microorganisms and microbiology. Learning and practicing professional skills in handling microbes. Thorough knowledge and application of good laboratory and good manufacturing practices in microbial quality control.

PO2 : At the end of the course the student should be able to develop thorough knowledge and understanding of concepts of Biochemistry, enzymes, microbial metabolism, growth, bioenergetics and physiology . Students will become efficient in managerial skills, able to employ analytical reasoning, problems solving and interpretation and documentation of laboratory experiments at a level suitable to succeed at an entry- level position in Microbiology.

CO1.	At the end of the course the student will have broad and balanced knowledge of Microbiology, history, general characters and classification of Microorganisms, Viz-Bacteria, Fungi, algae, protozoa and virus, Understanding the microbiological techniques, cultivation and detection of microorganisms. Comprehend evolutionary importance and economic significance of microorganisms and microbiology. Learning and practicing professional skills in handling microbes. Thorough knowledge and application of good laboratory and good manufacturing practices in microbial quality control..
CO2	At the end of the course the student should be able to develop thorough knowledge and understanding of concepts of Biochemistry, enzymes, microbial metabolism, growth, bioenergetics and physiology . Students will become efficient in managerial skills, able to employ analytical reasoning, problems solving and interpretation and documentation of laboratory experiments at a level suitable to succeed at an entry- level position in Microbiology..
CO3.	To develop in students a range of practical skills so that they can understand and assess risks and work safely

CO4	To develop in students the ability to apply standard methodology to the solution of problems in Microbiology
CO5	To provide students with industrial problem based knowledge and skill towards employment or higher education in Biotechnology or multi-disciplinary areas involving different branches of sciences
CO6	To provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes.
CO7	To develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of industrial problems
CO8	To instil critical awareness of advances at the forefront of Biotechnology
CO9	To prepare students effectively for professional employment or research degrees in Biotechnology
CO10	To build confidence in the candidate to be able to work on his own in Industry and Institution of higher education.

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

SEM	Course Outcomes (COs) / Program Outcomes(POs)	1	2	3	4	5	6	7	8
1	C-1	X	X	X			X		X
2	C-2		X	X	X	X		X	X
3	C-3	X	X	X	X		X		X
4	C-4		X	X		X	X	X	X
5	C-5,C-6	X	X	X			X	X	X
6	C-7,C-8			X	X	X	X	X	X
7	C-9,C-10,C-11			X	X	X	X		X
8	C-12,C-13,C-15			X	X	X	X	X	X

Course Articulation Matrix related 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.

Semester-I

B.Sc MICROBIOLOGY

Title of the Course: MB DSC-1T – General Microbiology

Course 1: MBL DSC-1T – General Microbiology		Course 2: OE MBL, Human Microbial Diseases		Course 3: SEC 1T MBL Microbiological analytical techniques and quality control	
Number of Credits	Number of hours/semester	Number of Credits	Number of lecture hours/semester	Number of Credits	Number of hours/semester
4	56 Theory	3	42	2	30
2	52 Practical			(1 hour Theory +2 hours Practical)	

Content of Theory Course 1 : DSC-1T, MBL 101, General Microbiology	56 Hrs
Unit –1 Introduction to Microbiology and Microscopy	14 Hrs
Chapter No.1: History of Microbiology Microbes and origin of life. History, scope and relevance of microbiology as a modern science. Branches of Microbiology, Contribution of Scientists in the field of microbiology- Anton von Leuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch and others.	5 Hrs
Chapter No. 2 Taxonomy Haeckel's Three Kingdom system, Whittaker's Five kingdoms classifications - Monera. Protista, Fungi, Plantae and Animalia. Principles and methods of classification. Different trends in classification of microorganisms	4 Hrs
Chapter No. 3: Microscopy Principles of Microscopy – Optical, Charge particle and Scanning probe microscope, Resolving power, Numerical Aperture, Working distance magnification and. Chromatic aberrations. Different types of Microscopes – Compound, Dark field, Stereo / Binocular microscopes, Inverted microscope, Phase contrast, Fluorescent microscope, Electron microscope - Scanning and Transmission electron microscope.	5 Hrs
Unit -2: General Characteristics of Microorganisms	14 Hrs
Chapter No. 4: General characteristics of Bacteria General characteristics of different important archaeal and eubacterial group's. Classification in brief based on Bergey's Manual of Systematic Bacteriology. Bacterial Cell structure and organization. Emphasis on Rickettsiae, Chlamydia, Spirochaetes, Mycoplasma, Actinomycetes.	4 Hrs
Chapter No. 5: Study of major groups of microorganisms Viruses: General characteristics of viruses. Concept of viroids, Satellite viruses, Bacteriophages, virusoids, virions and Prions. Structure and Importance of viruses.	

<p>Fungi: History and scope of Mycology, General Characteristics, Classification, Reproduction and significance of fungi</p> <p>Algae: History and scope of Phycology. General Characteristics, Classification, Reproduction. Economic importance of algae</p> <p>Protozoa: History of Protozoa. General Characteristics, Classification and, Reproduction</p>	6 Hrs
<p>Chapter No. 6: Culturing of microorganisms</p> <p>Types of culture media. Methods of isolation of bacteria and fungi - serial dilution, pour plate, spread plate and streak plate techniques..Cultivation of Anaerobic bacteria. Maintenance of Pure Cultures, Culture Collection Centres</p>	4 Hrs
Unit 3; Microbiological Techniques	14 Hrs
<p>Chapter No. 7: Sterilization Techniques</p> <p>A. Physical Methods and their mode of action : Heat (Dry and Moist heat),\ Filtrations and Radiations Methods</p> <p>B. Chemical methods : Definition of terms - disinfectants, antiseptics. Sanitizers, Microbicides -bactericides, virucide, Fungicide and Sporicide. Microbiostatic – bacteriostatic and fungistatic agents. Use and mode of action - Alcohols, aldehydes, halogens, phenols, heavy metals. Detergents: Quaternary ammonium compounds.</p>	5 Hrs
<p>Chapter No. 8: Stains and Staining techniques</p> <p>Principles and types of stains - Preparation of bacterial smears for light microscopy: Fixation, simple staining (Positive and Negative), Differential staining (Grams staining and Acid - Fast staining) Structural staining (Cell wall, Capsule, Flagella and Endospore staining)</p>	4 Hrs
<p>Chapter No. 9: Instruments</p> <p>Working principles and applications of Centrifuge. pH meter, Incubator, Colorimeter and Spectrophotometer. Chromatography- Working principles of Paper, Thin layer, Column and Ion-Exchange Chromatography</p>	5Hrs
Unit 4: Microbial Diversity	14 Hrs
<p>Chapter No. 10: Microbial Interactions.</p> <p>Basic principles and types of interactions among microorganisms. Inter and Intraspecific interactions. Merits and demerits of microbial interactions.</p>	4 Hrs
<p>Chapter No. 11: Microbial Ecology</p> <p>Ecology of Microbial cells and population ecology. Distribution and Significance of Microorganisms in air, water and soil</p>	4 Hrs
<p>Chapter No. 12 Bio-productivity</p> <p>Concepts and scope Methods used in the study of microbial diversity. Different levels of assessment and measure of microbial diversity, Factors influencing microbial diversity. Diversity as a source of innovation. Various approaches to improve microbial diversity and bioproductivity</p>	5 Hrs

PRACTICAL I

PAPER MB DSC-1P – General Microbiology

(4 hrs/week)

1. Laboratory safety: General rules and regulations.
2. Study of Microscope - Structure and working principles of Light microscope
3. Demonstrations of laboratory instruments: Autoclave, hot air oven, incubator, Laminar Air Flow, Centrifuge, pH meter, Colorimeter and Spectrophotometer..
4. Cleaning and sterilization of glassware.
5. Preparation of culture media - Broth, Semisolid and solid media. Isolation and Enumeration of microorganisms using serial dilution, Pour plate. Streak plate and spread plate techniques..
6. Isolation of microorganisms from air, water and soil and studying their characteristics.
7. Staining methods - Simple staining, Grams staining, Acid fast staining and structural staining.
8. Microscopic observations of Prokaryotes and Eukaryotes: Bacteria. Cyanobacteria, Protozoa, Fungi and Algae.
9. Study of Bacterial Motility by Hanging drop method
10. Micrometry and Camera lucida.
11. Counting of yeast cells and fungal spores by Haemocytometer.
12. Demonstration of slide culture technique of fungi
13. Demonstration of Chromatographic techniques (Paper Chromatography)

Text Books

1. Aneja K R 2017: Experimental in Microbiology Plant Pathology and Biotechnology. 5th Edition, New age International. New Delhi
2. Pelczar, Jr. Michael J. (2018). "Microbiology" 6thedn., Tata MaGraw HillBook Co. New York.
3. Ronald M Atlas, Richard Bartha, and David Atlas 1998: Microbial Ecology: Fundamentals and application 2nd Edition McMillan publishing Co. New York

References:

- ❖ Josephine A. Morello Paul A. Granato Helen Eckel Mizer (2003). "Laboratory Manual and Workbook in Microbiology". The McGraw–Hill Companies.
- ❖ Atlas, R. M. (1997). "Principles of Microbiology". 2nd edition. W.M.T. Brown Publishers Cappuccino, J.G and Sherman, N - 1999 "Microbiology" - a laboratory Manual Adeliason Wesley.
- ❖ Bhattacharya. (1986). "Experiments with microorganisms" - Emkay Publishers.
- ❖ Cappucino. J. and Sherman, N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.
- ❖ Carter, J. and Saunders, V. (2007). "Virology: Principles and Applications". John Wiley and Sons.
- ❖ Colwod, D.(1999). "Microbial Diversity" Academic Press.
- ❖ Vos, P., Goodfellow, M., Brenner, D. J., Castenholz, R. W. (2001). Bergey's Manual of Systematic Bacteriology: Volume Two: The Proteobacteria (PartC). Germany: Springer.
Kumar, H. D and Swati Kumar 2004: Modern concepts of Microbiology. 2nd Edition, Vikas Publishing House Pvt. Ltd. New Delhi
- ❖ Dubey, R. C. and Maheshawari, D.K, (2013). "Text book of Microbiology" S Chand

- and company limited, Ramnagar, New Delhi.
- ❖ Edward Alcamo T. (1997)."Fundamental of Microbiology - 5th edn., Adlison Wesley Longman Inc. New York.
 - ❖ Gunashekar, P. (2009)."Laboratory Manual in Microbiology"New Age Intl Ltd.
 - ❖ Madigan, M.T. Martinko, J.M and Parker, J.(1997)."Biology of Microorganisms-8th edn., McGraw Hill Inc. New York.
 - ❖ Nelson David, L and Cox Michael, M., Lehninger. (2008). "Principles of Biochemistry" Macmillan Press, Worth Publishers, New Delhi.
 - ❖ Norris J.R. and Ribbons. D.W. (1972)"Methods in Microbiology" volume 7b Academic Press, London / New York.
 - ❖ Powar and Daginwala (1994)"Microbiology" - Vol I and II. Himalaya Publication, New York.
 - ❖ Salle, A.J. (2007)."Fundamental Principles of Bacteriology" Tata McGraw Hill Publishing Company Ltd., New Delhi.
 - ❖ Srivastava, S. and Srivastava, P. S. (2003). "Understanding Bacteria". Kluwer Academic Publishers, Dordrecht.
 - ❖ Stanier, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. (2005). "General Microbiology". 5th edition McMillan.
 - ❖ SulliaS. Band Shantaram. S. (1998) "General Microbiology" Oxford and IBH Publishing Co PvtLtd. New Delhi.
 - ❖ Sundara R. Rajan. (2013)."Tools and Techniques of Microbiology" - Anmol Publications.
 - ❖ Gerard J. Tortora, Berdell R. Funke and Christine L. Case (2021). Microbiology: An Introduction, 13th Edition. Pearson Education.
 - ❖ Peleczar, M.J.. Chan. E.C.S and Krieg, N.R. (2020)"Microbiology"7th Edition. Tata MaGraw HillBook.
 - ❖ Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl and Thomas Brock. (2021). "Brock Biology of Microorganisms", 14th Edition.Pearson.
 - ❖ Joanne Willey and Kathleen Sandman and Dorothy Wood Eleventh edition.(2020). "Prescott's Microbiology". New York, NY : McGraw-Hill Education.
 - ❖ Stuart Hogg. (2013). "Essential Microbiology" 2nd Edition. Wiley-Blackwel

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.

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
TEST 1	10
TEST 2	10
Assignment/seminar	10
Total	30

Course 2: OE 1T MBL Human Microbial Diseases**(Credits: Theory-3)****THEORY****Total hours allotted: 42 hrs (3 hrs/week)**

	42 Hrs
Unit –1	11 Hrs
Introduction to medical microbiology: History and Development of Medical Microbiology. Normal flora of human body-skin, oral cavity, respiratory tract and urogenital tract. Infection-types of infection, modes of disease transmission, portal of entry of pathogen. Pathogenesis, virulence, attenuation and exaltation with an example each. Collection, transport and culturing of clinical samples.	
Unir-2	10
Bacterial diseases: Cultural and biochemical characteristics, pathogenesis, symptoms, mode of transmission, prophylaxis and control of Respiratory diseases (<i>Streptococcus pyogenes</i> , <i>Mycobacterium tuberculosis</i>). Gastrointestinal diseases: <i>Salmonella typhi</i> , <i>Helicobacter pylori</i> Others: <i>Bacillus anthracis</i> , <i>Treponema pallidum</i> .	
Unit- 3	10
Viral, Fungal and Protozoan disease Pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of Viral diseases (Dengue, AIDS, Rabies). A brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis. Fungal diseases-transmission, symptoms and prevention of cutaneous mycoses (Athlete's foot), systemic mycoses (Histoplasmosis) and opportunistic mycoses (Candidiasis). Protozoan diseases (Malaria, Kala-azar).	
Unit -4:	11
Anti microbial agents: General characteristics, and of types antibacterial agents. Mode of action of Antibacterial (Penicillin, Streptomycin) Antifungal (polyenes, flucytosine, the imidazoles, and triazoles), antiviral-Acyloguanosine. Antibiotic resistance, MDR, XDR, MRSA, NDM-1.	

References

- ❖ Ananthanarayan, R. and Paniker, C.K.J. (2018). "Textbook of Microbiology". 8th edition, University Press Publication.
- ❖ Goering, R., Dockrell Richard A., Kindt Thomas J. and Osborne Barbara A., Kuby, (2005) Immunology, W. H. Freeman and Company, H., Zuckerman, M. and Wakelin D. (2007).
- ❖ Richard V Goering, Cedric A Mims. (2008). Mims' "Medical Microbiology". 4th edition. Elsevier.
- ❖ Gupte, S.M.D.(1986)."The short text book of Medical Microbiology"⁷ Jaypee Brothers Medical Publishers New Delhi..
- ❖ Jagadish Chandra, (1996). "Text Book of Medical Mycology". Orient Longman.

- ❖ Jayaram Panicker, C.K. (1993). “Text Book of Medical Parasitology” Jaypee Brothers, Medical Publishers, New Delhi.
 - ❖ Kenneth Jr. (2001) “Medical Microbiology-Introduction to Infection Diseases” Prentice Hall International.
 - ❖ Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark, D. P. (2014). “Brock Biology of Microorganisms”. 14th edition. Pearson International Edition.
 - ❖ Peakman, M. and Vergani, D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinburgh.
 - ❖ Richard, C. and Geiffrey, S. (2009). “Immunology”. 6th edition. Wiley Blackwell Publication.
 - ❖ Roitt, I.M., (2016) “Essentials of Immunology”, ELBS, Blackwell Scientific Publishers, London.
 - ❖ Sengupta, J. (1988). "Synopsis of Clinical Pathology and Microbiology" Hilton and Co. Culcatta.
 - ❖ Topley and Wilson (2001) "Principles of Bacteriology. Virology and Immunity" Idward Arnold. Greenwood. David, Richards. C and Slack B. "Medical Microbiology".
 - ❖ Prescott's Microbiology (2020).Joanne Willey and Kathleen Sandman and Dorothy Wood Eleventh edition. New York, NY : McGraw-Hill Education
 - ❖ Gerard J. Tortora, Berdell R. Funke and Christine L. Case (2021). Microbiology: An Introduction, 13th Edition.Pearson Education.
 - ❖ Arun K. Bhunia. (2018). “Foodborne Microbial Pathogens” 2nd Edition. Springer New York
-
- ❖ Patricia Tille. (2015). “Baileys and scott's diagnostic microbiology” 14th Edition. Elsevier.
 - ❖ Kenneth Ryan and Nafees Ahmad and J. Andrew Alspaugh and W. Lawrence Drew and Megan Reller. (2018).“Sherris Medical Microbiology” MC Graw Hill education.
 - ❖ Stefan Riedel, Jeffery A. Hobden, Steve Miller, Stephen A. Morse, Timothy A. Mietzner, Barbara Detrick, Thomas G. Mitchell, Judy A. Sakanari, Peter Hotez, Rojelio Mejia. (2019). “Jawetz, Melnick, & Adelberg's Medical Microbiology” 28th E. MC Graw Hill education.

**Course 3: SEC 1T, MBL Microbial Analytical Techniques and quality control
(Credits: 2)**

Total hours allotted 30 hrs (one hour theory followed by 2 hours practicals)

- 1. Biosafety :** Good laboratory practices, Good microbiological practices Biosafety cabinets; Working of biosafety cabinets, using protective clothing, specification for BSL1, BSL-2, BSL-3. Discarding biohazardous waste-Methodology of Disinfection, Autoclaving & Incineration. **(8 hrs)**
- 2. Determining Microbes in Samples:** Culture and microscopic methods- Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products. Molecular methods - Nucleic acid probes, PCR based detection, biosensors. **(8 hrs)**
- 3. Microbiological quality analysis of Food and Water:** Enrichment culture technique, Detection of specific microorganisms- on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Saboraud Dextrose Agar. Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay). **(7 hrs)**
- 4. Food safety and Standard:** HACCP for Food Safety and Microbial Standards. Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations Microbial Standards for Different Foods and Water-BIS standards for common foods and drinking water. **(7 hrs)**

SEC-1P

Practicals: Microbiological analytical techniques and quality control

1. Isolation and enumeration of microorganisms from food utensils.
2. Isolation and enumeration of bacteria/fungi from spoiled vegetables/fruits.
3. Quantitative examination of bacteria in raw and pasteurized milk by SPC method.
4. Turbidity test to detect efficiency of sterilization.
5. Methylene blue reductase test and Resazurin test to determine the quality of milk.
6. Determination of efficiency of Pasteurization by Phosphatase test.
7. Casien hydrolysis test.
8. Litmus milk test.
9. Estimation of % of lactic acid present in given fermented dairy products.
10. Visit to food industries/ food research laboratories, dairy industries and distilleries.

SUGGESTED READINGS

- ❖ Baird, R. M., Hodges, N. A. and Denyer, S. P. (2005). Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
- ❖ Garg, N., Garg, K. L. and Mukerji, K. G. (2010). Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
- ❖ Harrigan, W. F. (1998). Laboratory Methods in Food Microbiology, 3rd ed. Academic Press.
- ❖ Jay, J. M., Loessner, M. J., Golden, D. A. (2005). Modern Food Microbiology, 7th edition. Springer.
- ❖ TimSandle.(2015). “Pharmaceutical Microbiology: essentials for quality assurance and quality control”.Woodhead Publishing.
- ❖ Frederick Kavanagh (Herausgeber).(2014).Analytical Microbiology. Elsevier Science .
- ❖ David Roesti, Marcel Goverde. (2019). Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non Sterile Manufacturing. Willey.
- ❖ Joanne Willey and Kathleen Sandman and Dorothy Wood Eleventh edition.(2020). “Prescott's Microbiology”. New York, NY : McGraw-Hill Education.
- ❖ Dubey, R. C. and Maheshawari, D.K, (2013). Text book of Microbiology, S Chand and company limited, Ramnagar, New Delhi.

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

Semester-II
B.Sc MICROBIOLOGY

Title of the Course: MB DSC-1T – General Microbiology

Course 1: MBL DSC- Microbial Biochemistry and Enzymology		Course 2: OE MBL, Food Borne infections	
Number of Credits	Number of hours/semester	Number of Credits	Number of lecture hours/semester
4 Theory	56 Theory	3	42
2 Practical	52 Practical		

Title of the Course: MB DSC-2T - Microbial Biochemistry and Enzymology

Content of Theory Course	56 Hrs
Unit 1. Biomolecules	18 Hrs
Chapter No.1: Carbohydrates Chemical and molecular basis of life- Monomer, multimer and polymeric units. A brief account of the properties, classification, characteristics and importance of Carbohydrates	5 Hrs
Chapter No. 2: Proteins Classification, general characteristics and properties of amino acid and proteins. Structural organization and significance of proteins.	5 Hrs
Chapter No. 3: Lipids Classification, General characteristics and properties of Lipids	4 Hrs
Chapter No. 4: Nucleic acids: General characteristics, Structure, types and significance of nucleic acids.	4 Hrs
Unit 2 : Enzymology	10 Hrs
Chapter No. 5: Enzymes: Nomenclature, classification, Characteristics and properties of enzymes. Enzyme kinetics-Michaeli's and Menten equation. Factors affecting enzyme activity-Competitive and non competitive inhibition and allosteric enzymes, cofactors, coenzymes, Ribozymes and their importance, clinical importance of enzymes.	6 Hrs
Chapter No. 6: Enzyme Regulation: Types, modes and mechanism of enzyme action, factors affecting enzyme action, enzyme regulation.	4 Hrs
Unit 3: Bioenergetics	14 Hrs
Chapter No. 7: Thermodynamics Laws of thermodynamics, Free energy, ATP and its production, other high-energy compounds, Oxidation and reduction reactions.	4 Hrs
Chapter No. 8: Energy yielding process Glycolysis, Outline of TCA cycle, Electron transport chain, Oxidative phosphorylation, Oxidation (alpha, beta and Omega oxidation pathway). Amino acid degradation (Transamination. Deamination and Decarboxylation). Anaerobic respiration Alcoholic, Lactic and acetic acid fermentation.	6 Hrs
Chapter No. 9: Bacterial Photosynthesis: Types of bacterial photosynthesis, Photosynthetic pigments. Light reactions. Dark reaction, Comparison of photosynthesis in green plants and bacteria, Oxygenic and Anoxygenic Photosynthesis. Mechanism of photosynthetic bacteria.	4 Hrs
Unit 4: Microbial Metabolism	14 Hrs
Chapter No. 10: Chemoheterotrophic Metabolism Concept and types of aerobic respiration, anaerobic respiration and fermentation.	

Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain- uncouplers and inhibitors. Pasteur effect.	4 Hrs
Chapter No. 11: Nitrogen and Lipids metabolism: Biological nitrogen fixation-symbiotic and asymbiotic nitrogen fixation, nodule formation, mechanism and biochemistry of N ₂ fixation, nitrification and denitrification. A brief account on lipid metabolism-biosynthesis of triglycerides, β -oxidation.	4 Hrs
Chapter No. 12: Microbial Nutrition and Growth Nutritional requirements, modes of nutrition – Autotrophs, Heterotrophs, Phototrophs. chemotrophs, methanotrophs, organotrophs and saprotrophs. Microbial Growth: Growth Rate, generation time and growth curve - phases of growth and their significance physical and chemical factors affecting growth - Temperature, Light. pH, Oxygen and saline requirements. Measurement of growth by cell number, cell mass and cell viability.	6 Hrs

PRACTICAL II

PAPER DSC-2P Microbial Biochemistry and Enzymology

(4 hrs / week)

- Qualitative tests for the detection of Carbohydrates
Glucose - Benedict's test, Molisch's test, Fehling's test and Picric acid test.
- Qualitative tests for Proteins and Amino acids
Protein -Biurette test. Ninhydrin test. Millons test and Xantho protein test.
- Qualitative tests for Lipids
Lipids - Acrolein test. Sudan III test, emulsification test and solubility test.
- Colorimetric estimation of sugar by DNS method.
- Colorimetric estimation of protein by burette method.
- Study of Bacterial Growth curve and Measurement of growth by cell mass using tubidometer/ photocolormeter/ spectrophotometer.
- Estimation of Saponification value of oils.
- Biochemical tests for the identification of bacteria
 - IMViC
 - Fermentation of glucose, sucrose and lactose - Acid and gas production.
 - Starch hydrolysis
 - Gelatin hydrolysis
 - Catalase test
- Effect of pH and temperature on bacterial growth.
- Assay of salivary amylase by DNS method, determination of specific activity.
- Effect of pH on enzyme activity
- Effect of temperature on enzyme activity

Text Books

- Nelson David, L and Cox Michael, M., Lehninger, (2008). "Principles of Biochemistry". Macmillan Press, Worth Publishers, New Delhi.
- Joanne Willey and Kathleen Sandman and Dorothy Wood Eleventh edition.(2020). "Prescott's Microbiology". New York, NY : McGraw-Hill Education.
- Hrudayanath Thatoi, Pradeep K. Das Mohapatra, Sonali Mohapatra Keshab C. Mondal.. (2020). "Microbial Fermentation and Enzyme Technology" CRC press Taylor and Francis group.

References:

- ❖ Atlas, R. M. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers
- ❖ Cappuccino, J.G and Shermani, N. (1999)."Microbiology - a laboratory Manual Adelioston Wesley.
- ❖ G. N. Cohen. (2014). "Microbial Biochemistry" 3rd Edition. Springer Nature.
- ❖ Goutam Brahmachari. (2016). "Biotechnology of Microbial Enzymes"1st Edition.London, UK : Academic Press
- ❖ Jose Luis Barredo. (2005). "Microbial Enzymes and Biotransformations" (Methods in Biotechnology) Humana Press.
- ❖ Dubey, R. C. and Maheshawari, D.K, (2013). "Text book of Microbiology", S Chand and company limited, Ramnagar, New Delhi.
- ❖ Gerard J. Tortora, Berdell R. Funke and Christine L. Case (2021). Microbiology: An Introduction, 13th Edition.Pearson Education.
- ❖ Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl and Thomas Brock. (2021). "Brock Biology of Microorganisms", 14th Edition.Pearson.
- ❖ Cooper T.G. (1997)."The tools of Biochemistry" John Wiley and sons.
- ❖ Peleczar, M.J.. Chan. E.C.S and Krieg, N.R. (2020)"Microbiology"7th Edition. Tata MaGraw HillBook.

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 and Physiology of microorganisms

Formative Assessment	
Assessment Occasion/ type	Weightage in Marks
TEST 1	10
TEST 2	10
Assignment/seminar	10
Total	30

OE-2T MBL Food borne microbial infections

(Credits: Theory-3)

THEORY

Total hours allotted: 42 hrs (3 hrs/week)

	42 Hrs
Unit –1	11 Hrs
1. Spoilage of food: Food as a substrate for growth of microorganisms. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods. Sources of contamination. Groups of bacteria important in food bacteriology. Microbial spoilage and preservation of fruits, vegetables, meat, poultry, fish and canned foods.	
Unit –2	10 Hrs
Principles and methods of food preservation: Physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids (propionates, benzoates, sorbates), SO ₂ , nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins.	
Unit –3	10 Hrs
Microbiology of milk: Sources of contamination of milk. Methods to detect microbial quality by SPC, Reductase test, Phosphatase test, clot on boiling test. Biochemical changes of milk-souring, gassy fermentation, proteolysis, lipolysis, ropiness. Starter culture and its role. Therapeutic value of Yoghurt, Butter milk. Cheese (preparation and types). Preservation of milk and milk products- Pasteurization.	
Unit -4	11 Hrs
Food infection and safety: Food infection (Salmonellosis, Shigellosis, <i>Yersinia enterocolitica</i> , <i>Listeria monocytogenes</i>) Food intoxication- (Aflatoxin, Staphylococcal Intoxication, Botulism). Food safety and quality control- brief account of HACCP, FSSAI and Food safety and standard act 2006.	

References

- ❖ Baird, R. M., Hodges, N. A. and Denyer, S. P. (2005). Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
- ❖ Garg, N., Garg, K. L. and Mukerji, K. G. (2010). Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
- ❖ Harrigan, W. F. (1998). Laboratory Methods in Food Microbiology, 3rd ed. Academic Press.
- ❖ Jay, J. M., Loessner, M. J., Golden, D. A. (2005). Modern Food Microbiology, 7th edition. Springer.
- ❖ Arun K. Bhunia. (2018). “Foodborne Microbial Pathogens” 2nd Edition. Springer New York
- ❖ Patricia Tille. (2015). “Baileys and scott's diagnostic microbiology” 14th Edition. Elsevier.
- ❖ Kenneth Ryan and Nafees Ahmad and J. Andrew Alspaugh and W. Lawrence Drew and Megan Reller. (2018). “Sherris Medical Microbiology” MC Graw Hill education.

- ❖ Stefan Riedel, Jeffery A. Hobden, Steve Miller, Stephen A. Morse, Timothy A. Mietzner, Barbara Detrick, Thomas G. Mitchell, Judy A. Sakanari, Peter Hotez, Rojelio Mejia. (2019). “Jawetz, Melnick, & Adelberg's Medical Microbiology” 28th E. MC Graw Hill education.
- ❖ Gerard J. Tortora, Berdell R. Funke and Christine L. Case (2021). Microbiology: An Introduction, 13th Edition. Pearson Education.
- ❖ Joanne Willey and Kathleen Sandman and Dorothy Wood Eleventh edition.(2020). “Prescott's Microbiology”. New York, NY : McGraw-Hill Education.
- ❖ Arun K. Bhunia. (2018). “Food borne Microbial Pathogens” 2nd Edition. Springer New York
- ❖ Patricia Tille. (2015). “Baileys and Scott's diagnostic microbiology” 14th Edition. Elsevier.
- ❖ Kenneth Ryan and Nafees Ahmad and J. Andrew Alspaugh and W. Lawrence Drew and Megan Reller. (2018).“Sherris Medical Microbiology” MC Graw Hill education.
- ❖ Stefan Riedel, Jeffery A. Hobden, Steve Miller, Stephen A. Morse, Timothy A. Mietzner, Barbara Detrick, Thomas G. Mitchell, Judy A. Sakanari, Peter Hotez, Rojelio Mejia. (2019). “Jawetz, Melnick, & Adelberg's Medical Microbiology” 28th E. MC Graw Hill education.
- ❖ Aneja K. R. (2018) Modern Food Microbiology. Medtech; 1st edition

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.

Faculty of Science & Technology
04 - Year UG Honors programme: 2021-22

GENERAL PATTERN OF THEORY QUESTION PAPER FOR DSCC/ OEC
(70marks for semester end Examination with 3 hrs duration)

Part-A

1. Question number 1-6 carries 2 marks each. Answer any 05 questions : 10 marks

Part-B

2. Question number 7- 14 carries 05Marks each, Answer any 06 questions : 30 marks

Part-C

3. Question number 15-18 carries 10 Marks each, Answer any 03 questions : 30 marks

(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary)

Total: 70 Marks

Note: Proportionate weightage shall be given to each unit based on number of hours prescribed.



KARNATAK UNIVERSITY, DHARWAD

PATTERN OF PRACTICAL EXAMINATION

Practical examination – B. Sc MICROBIOLOGY

Duration: 3 hours

Max. Marks: 35

Q. 1	Major question	12 Marks
Q. 2	Minor question	08 Marks
Q. 3	Identify and comment	5X1 = 05 marks
Q. 4	Record	05 Marks
Q. 5	Viva - Voce	05 Marks