Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur 440033

Scheme and Syllabus

Bachelor of Science (Microbiology)

Submitted by

Board of Studies,
Bachelor of Science (Microbiology)

FYUGP-Scheme I-VIII Semester

Bachelor of Science (Honors/Research)

(Microbiology - Major)

Four Year (Eight Semester Degree Course)

Teaching and Examination Scheme

B.Sc. Sem-I (Microbiology - Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				Th	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Fundamentals of Microbiology	BMI1T01	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Fundamentals of Microbiology	BMI1P01	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Basic Techniques in Microbiology	BMI1T02	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Basic Techniques in Microbiology	BMI1P02	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO1T01	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO1T02	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Calibration, validation and handling of laboratory equipment	BVS1P01	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS1P02	-	-	4	2	-	-	-	-	50	50	50
9	AEC	English Compulsory	BAE1T01	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Environmental Sci.	BVE1T01	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Vedic Mathematics	BIK1T01	2	-	-	2	3	80	20	40	-	-	-
12	CC	Refer CC Basket	BCC1P01	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**530**	**170**		**125**	**275**	

B.Sc. Sem-II(Microbiology- Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Microbial Diversity	BMI2T03	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Microbial Diversity	BMI2P03	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Chemistry of Biomolecules	BMI2T04	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Chemistry of Biomolecules	BMI2P04	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO2T03	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO2T04	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Preparation and standardization of Lab reagents	BVS2P03	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS2P04	-	-	4	2	-	-	-	-	50	50	50
9	AEC	Second Language	BAE2T02	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Constitution of India	BVE2T02	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Indian Astronomy	BIK2T02	2	-	-	2	3	-	-	-	50	50	50
12	CC	Refer CC Basket	BCC2P02	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**530**	**170**		**125**	**275**	

Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor

B.Sc. Sem-III (Microbiology- Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Metabolism	BMI3T05	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Metabolism	BMI3P05	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Environmental Microbiology	BMI3T06	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Environmental Microbiology	BMI3P06	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 1 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 1 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 2 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 2 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO3T05	2	-	-	2	3	80	20	40	-	-	-
10	VSC	Refer VSC Basket	BVS3P05	-	-	4	2	-	-	-	-	50	50	50
11	AEC	Second Language	BAE3T03	2	-	-	2	3	50	50	40	-	-	-
12	FP	Field Project	BFP3P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC3P03	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

B.Sc. Sem-IV (Microbiology- Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Food Microbiology	BMI4T07	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Food Microbiology	BMI4P07			2	1	-	-	-	-	25	25	25
3	DSC	Dairy Microbiology	BMI4T08	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Dairy Microbiology	BMI4P08			2	1	-	-	-	-	-	50	25
5	Minor	Minor 3 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 3 (Refer Minor Basket)				2	1	-	-	-	-	25	25	25
7	Minor	Minor 4 (Refer Minor Basket)		2	-		2	3	80	20	40	-	-	-
8	Minor	Minor 4 (Refer Minor Basket)				2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO4T06	2	-	-	2	3	80	20	40	-	-	-
10	SEC	Refer SEC Basket	BVS4T06	-	-	4	2	-	-	-	-	50	50	50
11	AEC	Compulsory English	BAE4T03	2	-	-	2	3	50	50	40	-	-	-
12	CEP	Community Service	BCM4P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC4P04	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship ORContinue with Major and Minor

B.Sc. Sem-V (Microbiology- Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min.
1	DSC	Medical Microbiology- Host Parasite Relationship	BMI5T09	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Medical Microbiology- Host Parasite Relationship	BMI5P09	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Molecular Biology	BMI5T10	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Molecular Biology	BMI5P10	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Immunology	BMI5T11	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Immunology	BMI5P11	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 1	BMI1T12	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 1	BMI1P12	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 5 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 5 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	Minor	Minor 6 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
12	Minor	Minor 6 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
13	VSC	Refer VSC Basket	BVS5P07	-	-	4	2	-	-	-	-	50	50	50
14	CEP	Community Service	BCM5P02	-	-	2	1	-	-	-	-	25	25	25
Total				**13**	**-**	**18**	**22**	**-**	**520**	**130**	**--**	**150**	**300**	**-**

B.Sc. Sem-VI (Microbiology- Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Industrial Microbiology	BMI6T13	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Industrial Microbiology	BMI6P13	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Medical Microbiology- Microbial Diseases	BMI6T14	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Medical Microbiology- Microbial Diseases	BMI6P14	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Recombinant DNA Technology and Applications	BMI6T15	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Recombinant DNA Technology and Applications	BMI6P15	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 2	BMI6T16	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 2	BMI6P16	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 7 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 7 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	VSC	Refer VSC Basket	BVS6P08	-	-	4	2	-	-	-	-	50	50	50
12	OJT	Internship (Related to DSC)	BOJ6P01	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	22	**22**		**440**	**110**		**225**	**325**	

Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor

B.Sc. Sem-VII (Honors) (Microbiology- Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Enzymology –I	BMI7T17	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Enzymology –I	BMI7P17	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Virology-I	BMI7T18	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Virology-I	BMI7P18	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Bioinstrumentation II	BMI7T19	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Bioinstrumentation II	BMI7P19	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Microbial Metabolites	BMI7T20	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Microbial Metabolites	BMI7P20	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 3	BMI7T21	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 3	BMI7P21	-	-	2	1	-	-	-	-	25	25	25
11	RM	Research Methodology	BMI7T22	2	-	-	2	3	80	20	40	-	-	-
12	RM	Research Methodology	BMI7P22	-	-	4	2	-	-	-	-	50	50	50
Total				13	-	14	**20**		**520**	**130**		**125**	**225**	

B.Sc. Sem-VIII (Honors) (Microbiology- Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Enzymology-II	BMI8T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Enzymology-II	BMI8P23	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Virology -II	BMI8T24	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Virology -II	BMI8P24	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Bioinstrumentation – II	BMI8T25	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Bioinstrumentation – II	BMI8P25	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Biomolecules and their Interactions	BMI8T26	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Biomolecules and their Interactions	BMI8P26	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 4	BMI8T27	3	-	-	3	3	120	30	60	-	-	-
10	DSE	Elective 4	BMI8P27	-	-	2	1	-	-	-	-	25	25	25
11	OJT	Apprenticeship (Related to DSC)	BOJ8P02	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

Four Year UG Honours Degree in Major and Minor with 160-176 credits

B.Sc. Sem-VII (Research) (Microbiology- Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
								Theory				Practical		
				(Th)	TU	P		Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Enzymology –I	BMI7T17R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Enzymology –I	BMI7P17R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Virology-I	BMI7T18R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Virology-I	BMI7P18R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Bioinstrumentation – I	BMI7T19R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Bioinstrumentation – I	BMI7P19R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 3	BMI7T20R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 3	BMI7P20R	-	-	2	1	-	-	-	-	-	50	25
9	RM	Research Methodology	BMI7T21R	2	-	-	2	3	80	20	40	-	-	-
10	RM	Research Methodology	BMI7P21R	-	-	4	2	-	-	-	-	50	50	50
11	RP	Research Project/ Dissertation (Core)	BRP7P01	-	-	6	3	-	-	-	-	75	75	75
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

'R' in the subject code indicates 'Research'.

B.Sc. Sem-VIII (Research) (Microbiology- Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Enzymology-II	BMI8T22R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Enzymology-II	BMI8P22R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Virology -II	BMI8T23R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Virology -II	BMI8P23R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Bioinstrumentation –II	BMI8T24R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Bioinstrumentation –II	BMI8P24R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 4	BMI8T25R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	Elective 4	BMI8P25R	-	-	2	1	-	-	-	-	-	50	25
9	RP	Research Project / Dissertation (Core)	BRP8P02	-	-	14	7 (4+2 +1)	-	-	-	-	175	175	175
Total				09	-	22	**20**		**360**	**90**		**225**	**325**	

'R' in the subject code indicates 'Research'.

Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits

Total Credits:

1. Three Year UG Degree Program: 132
2. Four Year UG Degree Program: 172

Abbreviations: Generic/Open Electives: OE, Vocational Skills & Skill Enhancement Courses: VSEC, Vocational Skill Courses: VSC, Skill Enhancement Courses: SEC, Ability Enhancement Courses: AEC, Indian Knowledge Systems: IKS, Value Education Courses: VEC, On Job Training (Internship/Apprenticeship): OJT, Field Project: FP, Community Engagement & Service: CEP, Co-curricular Courses: CC, Research Methodology: RM, Research Project: RP

VSC Basket (Microbiology)

Semester	Course Category	Name of Course	BoS	Course Code
I	**VSC**	Calibration, validation and handling of laboratory equipment	Microbiology	**BVS1P01**
II	**VSC**	Preparation and standardization of Lab reagents	Microbiology	**BVS2P03**
III	**VSC**	Diagnostic Microbiology	Microbiology	**BVS3P05**
V	**VSC**	Water analysis	Microbiology	**BVS5P07**
VI	**VSC**	Biofertilizers & Biopesticides	Microbiology	**BVS6P08**

Basket for <u>ELECTIVE</u> (DSE) Category Courses (Microbiology- Major)

Semester	Course Category	Name of Course	Course Code
V	Elective 1	A. Bioprocess Technology B. Haematology and Clinical Biochemistry	BMI5T12
VI	Elective 2	A. Applied Agricultural Microbiology B. Biostatistics	BMI6T16
VII (Honors)	Elective 3	A. Drug, Vaccine and Disease Management B. Bioinformatics	BMI7T21
VIII (Honors)	Elective 4	A. Pharmaceutical Microbiology B. Bioethics, Biosafety and IPR	BMI8T27
VII (Research)	Elective 3	A. Drug, Vaccine and Disease Management B. Bioinformatics	BMI7T20R
VIII (Research)	Elective 4	A. Pharmaceutical Microbiology B. Bioethics, Biosafety and IPR	BMI8T25R

R' in the subject code indicates 'Research'.

Introduction:

Microbiology is a branch of science that deals with study of microorganism i.e. bacteria, protozoa, algae, fungi, viruses. It studies their interaction with their environments as well as how these organisms are harnessed in human endeavour and their impact on society. The microbiological study has wide range of scope ranging from basic sciences to applied sciences. Microbiological study is mainly focused on health care, agricultural, food, dairy, environmental and industrial use.

Microbiology is at the heart of the healthcare industry, whether they're developing diagnostic kits, vaccines, biologics, pharmaceuticals, or medical gear. Microbiology fields such as molecular biology, cell biology, recombinant technology, and immunotherapeutic benefited from the medical sector's evolution. For those interested in a career in Medical Microbiology, there are numerous career prospects in health care/ pharma industry in various departments such as- production, R&D, QC, sales & marketing, content writing/ technical writing etc. & entrepreneurship. Also can be employed in diagnostic centres, in hospitals as laboratory staff or paramedical, hospital management as bio safety & hygiene management staff. In Medical academics also contribution can be given.

In Agriculture low crop yield, crop quality deterioration, weeds, loss of soil fertility, abiotic stress, and biotic stress are the issues to be addressed. Microorganisms are also helpful in enhancing the crop productivity. Our students are entrepreneur in this field. The biofertilizers, biopesticides are produced in bulk and are commercialized by few of our students. Incidentally biofertilizers are ecofriendly. In this field students can get employment in govt. sector, private sector in production, QC, R&D, Academics & a vast scope for entrepreneurship.

Food microbiology overcomes challenges in food production, processing, and preservation. The production of value-added food products are the greatest examples. In food & beverage industry microbiologists play an important role in production, QC, R& D, supply chain management. Many fermented products are produced where microbiologist have a key role. Dairy industry also demands microbiologists as it produces packed milk to development of fermented products. Functional foods like probiotic foods & single cell proteins are the examples. Food Safety is a new area for employment. For entrepreneurship large opportunities are available. Packed Mineral water is another sector. Food industry provides large scope for microbiologist. Our students have occupied jobs at different food industries. Microbiology always helps in introducing technology which aims to enhance the production, processing, packaging and preservation of food also.

Environmental microbiology aims to restore the balance between nature, ecology and human interest. Bioremediation and biological intervention is only possible by the way of utilization of techniques of microbiology. All these issues are now being addressed by using biotech processes. Microbes like bacteria, fungi algae and plants are being used in the process of bioremediation.

Beside job opportunities in the sector of agriculture, pharmaceutical and food industries our

students are working as research fellow at various National Institutes. Many students are working as Assistant Professor in colleges, Laboratory Technicians at Government and private pathological laboratories**.**

Objectives to be achieved

- To enrich Knowledge and train them in field of Microbiology
- To aware students about applied Microbiology as well as in research field
- To inculcate sense of scientific responsibilities and social and environment awareness
- To get successful career in the Microbiology field

Course Structure:

- As per scheme given in table
- For the purpose of computation of workload, the following mechanism may be adopted as per UGC guidelines:
  - i) 1 Credit = 1 Theory period of one-hour duration per week
  - ii) 1 Credit = 1 Tutorial period of one-hour duration per week
  - **iii)** 1 Credit = 1 Practical period of two-hour duration per week

B. Sc. Semester-I
Discipline Specific Core Course (DSC-1)-MICROBIOLOGY - Paper-I
(BMI1T01) (FUNDAMENTALS OF MICROBIOLOGY)

DSC-1 THEORY	**Hours: 2+2=04 Hours /Week**	**Marks: 80+20=100**	**Credit: 2+1=03**
	Unit-I		
History of Microbiology	1. Discovery of Microbes, 2. Theory of biogenesis & abiogenesis 3. Contributions of- Antonie van Leeuwenhoek, Louis Pasteur , Robert Koch, Joseph Lister, Winogradsky, Beijerinck, John Tyndall, Thomas M. Rivers 4.Branches of Microbiology- Definition and scope of a) Systemic Microbiology- Bacteriology, Mycology, Phycology, Virology, b) Biotechnology, c) Geo microbiology, d)Exobiology, e) Medical microbiology, f) Environmental MicrobiologY g) Industrial Microbiology h) Food Microbiology.		**7 Hrs**
	Unit-II		
Bacterial cell structure	1. Differences between prokaryotes and eukaryotes 2. Description of sizes, shapes and arrangements of bacteria 3. **Typical Bacterial cell structure**- a) Structure of cell wall (Gram positive & Gram negative bacteria) b) Cell membrane:- Fluid mosaic model, mesosomes 4. Ribosomes, Nucleoid, Plasmids, cytoplasmic inclusions 5. Capsules, slime layer, pilli, flagella 6. Endospore structure- formation, germination. 7. Exospores, Myxospores, Eukaryotic spores 8. Significance of dormancy		**7 Hrs**
	Unit III		
Microbial Nutrition	1. Nutritional types of bacteria 2. Basic nutritional requirements. 3. Types of culture media- Selective, Differential, Enriched, Synthetic and non synthetic (Definition, ingredients, principle and applications). 4. Media for isolation of fungi- Definition, ingredients, principle and applications 5. Enrichment Culture		**8 Hrs**

Unit IV		
Microbial growth	1. Bacterial reproduction. 2. Axenic cultures. 3. Growth curve 4. Mathematical expression of growth. 5. Continuous culture – Chemostat and turbidostat 6. Synchronous growth 7. Diauxic culture 8. Factors influencing microbial growth.	**8 Hrs**

Reference Books:

1. Prescott, Hurley. Klein-Microbiology, 7th edition, International edition, McGraw Hill.
2. Kathleen Park Talaro& Arthur Talaro - Foundations in Microbiology International edition 2002,| McGraw Hill.
3. Michael T. Madigan & J. M. Martin, Brock, Biology of Microorganisms 12th Ed. International edition 2006, Pearson Prentice Hall
4. A.J. Salle, Fundamental Principles of Bacteriology.
5. Stanier. Ingraham et al ,General Microbiology 4th & 5th Ed. 1987, Macmillan Education Ltd
6. Microbiology TMH 5th Edition by Michael J. Pelczar Jr., E.C.S. Chan ,Noel R. Krieg
7. Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. Adisson Wesley Longman Inc. 1998.
8. Kanungo R. (2017). Ananthanarayan and Paniker's Textbook of Microbiology. 10th edition. Universities Press, Hyderabad, India
9. Powar C. B. and Daginawala H. I. (2005). General microbiology Volume I. Himalaya Publishing House Private Limited, Pune, India.
10. Powar C. B. and Daginawala H. I. (2005). General microbiology Volume II. Himalaya Publishing House, Private Limited, Pune, India
11. Reddy S. M., Girisham S. and Narendra Babu G. (2017). Applied Microbiology (Agriculture, Environmental, Food and Industrial Microbiology). Scientific Publishers, Jodhpur, Rajasthan, India

List of Experiments:
Perform at least 5 practical (Excluding 1, 2 & 3).

1. General guidelines for safety in microbiology laboratory, possible laboratory hazards, safety precautions and disposal of laboratory waste and ethics in microbiology.
2. General concept of basic equipments & apparatus.
3. Preparation of media & stains.
4. Study of permanent slides of Streptococci, Diplococci, Capsule forming bacteria, Micrococcus sp. *Clostridium tetani*, *Bacillus anthracis*, *Vibrio cholera*, *Mycobacterium tuberculosis, Treponema palladium,* Cell organelles
5. Demonstration of microbes from environment, skin & teeth – Study colony characteristics (Major).
6. Staining—Simple staining.
7. Differential staining - Gram staining,(Major).
8. Bacterial motility by hanging drop method (Major).
9. Anaerobic cultivation of bacteria.
10. Effect of pH or temperature on growth of bacteria. (Major)
11. Measurement of microbial cell size by Micrometry. (Major)

Scheme of practical examination-

1. One long expt.----------..10 Marks
2. One short expt.----------..05 Marks
4. Viva-voce----------05 Marks
5. Record----------05 Marks

Total Marks= 25

Course outcomes

After this course the students will be able to

Sr. No.	Course outcome
1.	Students will understand the contributions of different scientists in the fields of Microbial science..
2.	Students will have knowledge about the established and emerging fields of science with respect to Microbiology.
3.	Students will have knowledge about basic structure & nutritional requirement of bacteria
4.	Develop practical skills to handle microorganism aseptically
5.	Understand the use of apparatus and their use without fear.
6.	Correlate their Microbiology theory concepts with practical outcomes.

B. Sc. Semester-I Discipline Specific Core Course (DSC-2)-MICROBIOLOGY - Paper- II (BMI1T02) (BASIC TECHNIQUES IN MICROBIOLOGY)			
DSC-2 THEORY	**Hours: 2+2=04 Hours /Week**	**Marks: 80+20=100**	**Credit: 2+1=03**
Unit-I			
Microscopy	**Principle, applications and ray diagram:** 1. Simple, compound microscope—Bright field Microscopy, 2. Dark field Microscopy, 3. Electron microscopy (TEM, SEM), 4. Phase-contrast microscopy, 5. Fluorescent microscopy.		**7 Hrs**
Unit-II			
Staining Techniques.	1. Stains & dyes, chromophore, auxochrome, chromogenes, types of stains 2. Theories of staining 3. Staining techniques : Simple, negative staining, differential staining- Gram staining, acid-fast staining 4. Staining of specific structures: flagella , spores, capsule		**7 Hrs**
Unit III			
Microbial Techniques	1. Isolation of pure culture by various methods. 2. Determination of nutritional requirement by auxonographic technique, replica plating technique & multi-point inoculator technique. 3. Measurement of growth 4. Preservation of microorganisms, National & international collection centers		**8 Hrs**
Unit IV			
Microbial control	1. Terms & definitions used in microbial control- Sterilization, inhibition, Microbiostatic, microbicidal, disinfectant, sanitizer, viricide, sporicide, antimetabolite antibiotic, germicide, Preservative etc. 2. Concept of microbial death 3. Properties of ideal antimicrobial agent. 4. Physical control methods—types, mode of action & applications only-a) High & low temperature b) filtration c) radiation d) osmotic pressure. 5. Chemical agents—Different types, mode of action & applications only- a) Phenols b) Alcohols c)Halogenes d) Heavy metals e) Quaternary ammonium compounds f) surface active agents g) phenol-coefficient 6. Mechanism of cell injury 7. Chemotherapeutic agent—sulphonamides only- mode of action & application, Antibiotics, examples according to mode of action, source		**8 Hrs**

Reference books -

1. Introduction to Microbial Techniques by Gunasekaran
2. Microbiology: Fundamentals and Applications by Ronald M. Atlas, New York: Macmillan Publication
3. Powar C. B. and Daginawala H. I. (2005). General microbiology Volume I. Himalaya Publishing House Private Limited, Pune, India.
4. Powar C. B. and Daginawala H. I. (2005). General microbiology Volume II. Himalaya Publishing House, Private Limited, Pune, India
5. Debnath M., Prasad G. B. and Bisen P. S. (2012). Microbes: Concepts and Applications. Germany: Wiley.
6. McDonnell G. E. (2020). Antisepsis, Disinfection, and Sterilization: Types, Action, and Resistance. United States: Wiley.
7. Pelczar M. J. Jr., Chan E.C.S. and Krieg N. R. (2010). Microbiology: An Application based Approach. McGraw-Hill Education (India) Private Limited, New Delhi, India.
8. Pierce B. E. and Leboffe M. J. (2019). Microbiology: Laboratory Theory and Application: Essentials. United States: Morton Publishing
9. Tortora G. J., Funke B. R. and Case C. L. (2016). Microbiology: An Introduction. Twelfth edition. Pearson, London.
10. Sharma K. (2007). Manual of Microbiology (Second Edition). ANE Books, New Delhi, India.

List of Experiments:
Perform at least 5 practical (Excluding 1)

1. General guidelines for safety in microbiology laboratory, possible laboratory hazards, safety precautions and disposal of laboratory waste and ethics in microbiology.
2. Isolation of pure culture by streak & spread plate method,
3. Isolation of pure culture by serial dilution and pour plate method. (Major).
4. Effect of Oligodyanamic action of heavy metal on microbial growth. (Major).
5. Effect of UV radiation on bacteria. (Major).
6. Effect of salt & sugar concentration on bacterial growth. (Major).
7. Bacterial endospore staining.
8. Capsule Staining.
9. Staining of Metachromatic granules.
10. Flagella Staining.

Scheme of practical examination as per Paper 1 practical.

COURSE OUTCOMES

After this course the students will be able to

Sr. No.	Course outcome
1.	Students will be able to understand the needs and basics of techniques used in observing microbes.
2.	Students will be aware of applications of basic techniques.
3.	Students will learn sterilization and disinfection principles and procedures
.4	Students will learn cultivation & aseptically handling of microorganism.

Calibration, Validation & Handling of Laboratory Equipments
Course Code: (BVS1P01)

VSC	Hours: 04 Hours /Week	Marks: SEE= 50 CIE= 50	Credit: 02

60 Hrs

LIST OF EXPERIMENTS
(Perform at least 10 practical)

1. Calibration, validation and handling of Ph meter
2. Calibration, validation and handling of Incubator
3. Calibration, validation and handling of Oven
4. Calibration, validation and handling of Laminar Air Flow
5. Calibration, validation and handling of Autoclave
6. Calibration, validation and handling of Electric Balance
7. Calibration, validation and handling of Thermometer
8. Calibration, validation and handling of Pressure Gauge
9. Handling and general maintenances of Microscope
10. Washing and cleaning of Laboratory glass ware for Microbiological work
11. Handling of centrifuge machine
12. Calibration of colorimeter
13. Calibration constant temperature water bath

Scheme of Practical Examination:

1. Two long expt.----------. 15 Marks each
2. Viva-voce---------- 10 Marks
3. Record---------- 10Marks

Total Marks = 50

Reference Books:

1. Praful B. Godkar and Darshan P Godkar, 2011, Textbook of Medical Laboratory Technology 2nd edition, Bhalani publishing house, Mumbai
2. Fischbach, 2005. Manual of lab and diagnostic tests, Lippincott Williams Wilkins, New York
3. J Ochei & Kolhatkar, 2002. Medical laboratory science theory and practice, Tata McGraw- Hill,
4. New Delhi.
5. Indian Pharmacopoeia Commission (IPC)
6. U.S. Pharmacopoeia (USP)

Course outcomes

After this course the students will be able to

Sr. No.	Course outcome
1.	Student will learn the basic knowledge of calibration, validation handling of laboratory instruments
2.	The knowledge is very useful for opting job in industries.

B.Sc. SEMESTER – I

BVE1T01: ENVIRONMENTAL SCIENCE

COURSE OUTCOMES:

At the end of the course, students shall be able to:

- Explain the basics of Environmental Science and Atmospheric Science along-with the components of Environment
- Explicate the importance of Environmental Education.
- Elucidate the fundamentals of atmospheric science including formation, depletion and effects of ozone layer and acid rain on environment.
- Describe the various physical and chemical characteristics and properties of Water and Soil
- Understand the Ecology and its allied branches
- Comprehend about Population and Community Ecology
- Study the changes in Population by understanding the concept of Population ecology

Unit-I: Basics of Environmental Science (7.5 Hrs)

A. Introduction of Environmental Science: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.
B. Environmental Education: Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness.
C. Components of Environment: Atmosphere (Structure and composition),hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere.

Unit-II: Basics of Atmospheric Science (7.5 Hrs)

A. Atmospheric Chemistry: Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.
B. Green House Effect: Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. Ozone depletion: chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.
C. Acid Rain: Chemistry of Acid Rain, effect of acid rain on ecosystem, control measures. Precipitation – Forms of precipitation (rain, drizzle, snow, sleet, and hail), types of precipitation (conventional, orographic, and cyclonic).

Unit-III: Basics of Ecology (7.5 Hrs)

A. Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.
B. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.
C. Biotic Factor: Inter specific relationship Positive: Mutualism (symbiosis), commensalism, proto-cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism.

Unit-IV: Ecosystems and food chain (7.5 Hrs)

A. Ecosystem: Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)
B. Food chain: Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological pyramids (number biomass and energy), energy flow in ecosystem (Y- shaped). Energy flow and the law of thermodynamics.
C. Biogeochemical Cycles: Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

Reference Books:

1. Text Book of Environment: K M Agrawal, P.K. Sikdar, and S.C. Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C. Dash and P.C. Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C. Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K. Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S. Dara, S.Chand Publication ,New Delhi.
6. Environmental Chemistry: A.K. Dey, New Age International Publishers,2001.
7. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr

P.U. Meshram, Allied Publishers, New Delhi.

8. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi,1996.
9. Animal Ecology and Distribution of Animals: Veer Bala Rastogi , Rastogi Publication, Meerut (U.P).
10. Ecology and Environment: P.D.Sharma, Rastogi Publication ,Meerut (U.P).
11. Fundamentals of Environmental Biology: S. Arora, Kalyani Publishers.
12. Environmental Biology: P.K.G. Nair, Himalaya Publication.
13. Environmental Biology: K.C. Agrawal, Agro Botanical Publisher ,Bikaner,1994

Indian Knowledge System (IKS)

SEM1: VEDIC MATHEMATICS (BIK1T01)

Course Outcomes: This course will enable the students to

1. Improve speed and accuracy in numerical calculations
2. Acquire IQ skills and high-end technical knowledge
3. gain test taking skills & creativity of calculations

UNITS	TOPICS	HOURS
Unit 1	(i)Addition - Subtraction - Combined operations - Beejank (ii) Multiplication methods: Urdhwatiryagbhayam, Nikhilam, Ekanyunen, Ekadhiken, Antyayordashakepi. (iii) Vinculum - Operations. (iv) Awareness of 1 to 5 Vedic sutras as per Shankaracharya Bharthikrishan Teerthji Swamiji's book.	**8**
Unit 2	(i) Division methods : Nikhilam, Paravartya Yojayet, Dhwajank(ii) GCD and LCM (iii) Expression of GCD in terms of two numbers.	**8**
Unit 3	(i) Divisibility tests, Osculation & Reverse osculation. (ii) Division Algorithm, Quotient & Remainder. (iii) Duplex method.	**7**
Unit 4	i) Squares & Square-roots for 6 digit number. (ii) Cubes & Cube-roots for 6 digit number, Contribution of Indian Mathematicians in Arithmetic.	**7**
	TOTAL	**30 HRS**

Reference Books:

1. Tirthaji B.K. (1965) Vedic Mathematics, MotilalBanarsidass
2. Bidder G.P. (1856) On Mental Calculation. Minutes of Proceedings, Institution ofCivil Engineers (1855-56), 15, 251-280
3. Scripture E.W. (1891) American Journal of Psychology. Vol. IV 1-59
4. Mitchell F.D. (1907) American Journal of Psychology. Vol. XVIII 61-143
5. Aitken A.C. (1954) The Art of Mental Calculation: With Demonstrations. Transactions of the Society of Engineers. 45, 295-309
6. Dow A. (1991) A Unified Approach to Developing Intuition in Mathematics, Scientific Research on the Transcendental Meditation and TM-Sidhi Program Vol 5,3386-3398
7. Williams K.R. (1984) Discover Vedic Mathematics. Vedic Mathematics Research Group

Nicholas, Williams, Pickles (1984) Vertically and Crosswise. Inspiration Books

B. Sc. Semester-II Discipline Specific Core Course (DSC-)-MICROBIOLOGY - Paper-III (BMI1T03) (MICROBIAL DIVERSITY)			
DSC - 3 THEORY	**Hours: 2+2=04 Hours /Week**	**Marks: 80+20 = 100**	**Credit: 2+1=03**
Unit-I			
Prokaryotic microbes	1. General characters of a) Proteobacteria, b) Mycoplasma, c) Rickettsia and d) Chlamydia 2. Cyanobacteria: Characteristics of anabena and applications of cyanobacteria 3. Actinomycetes: Characteristics of Streptomyces and their applications 4. Archae bacteria: Types of archae bacteria (Brief description), Methanogenic bacteria and their importance		**7 Hrs**
Unit-II			
Eukaryotic microbes	1. Fungi and yeast: General characters, Asexual and sexual mode of reproduction, 2. Algae:-General characters and industrially important algal cells 3. Protozoans: General characters and life cycle Of *Entamoeba histolytica*		**7 Hrs**
Unit III			
Acellular microbes: Viruses.	1. Discovery of viruses, General structure, symmetry and classification 2. Cultivation, chick embryo & tissue culture method 3. Detection of viral growth 4. T4-Bacteriophages- lytic cycle, 5. Lambda phage- Lysogenic cycle.		**8 Hrs**
Unit IV			
Microbial interaction	1. Positive and negative interaction: Commensalism, synergism, syntropism, mutualism, parasitism, predation, antagonism, competition 2. Life cycle of Bdellovibrio 3. Protist-Plant interaction: Root nodule bacteria 4. Protist-Animal interaction: Rumen bacteria, insect midgut bacteria, luminescent bacteria		**8 Hrs**

Reference Books:

1. Prescott, Hurley. Klein-Microbiology, 7th edition, International edition, McGraw Hill.
2. Stanier.Ingrahametal, General Microbiology 4th & 5th Ed.1987, Macmillan Education Ltd
3. Microbiology An Introduction. 6th Edition. Tortora, Funke and Case. Adisson Wesley Longman Inc. 1998.
4. Powar C. B. and Daginawala H. I. (2005). General microbiology Volume I. Himalaya Publishing House Private Limited, Pune, India.
5. Powar C. B. and Daginawala H. I. (2005). General microbiology Volume II. Himalaya Publishing House, Private Limited, Pune, India
6. Madigan M.T, Martinko J M, Dunlap P V and Clark. D P. 2008. Brock Biology of Microorganisms. 12th Ed. Pearson/ Prentice Hall
7. Arora B. and Arora D. R. (2020). Practical Microbiology. CBS Publishers and Distributors, New Delhi, India.
8. Tortora G. J., Funke B. R. and Case C. L. (2016). Microbiology: an Introduction. Twelfth edition. Pearson, London.

List of Experiments:
Perform at least 5 practical

1. Study of permanent slides of special bacteria--- Fungi (*Aspergillus, Penicillium* and *Mucor*) Protozoa (*Plasmodium vivax*, *Trypanosoma* and *amoeba*) & Algae (*Spirullina, Anabena* and *Euglena*), *Mycoplasma, Rickettsia* and *Chlamydia.*
2. Slide culture techniques for the cultivation and study of mould. (Major)
3. Isolation of Anabaena and study its morphology
4. Isolation of Protozoa from water.
5. Isolation of Bacteriophage. (Major)
6. Isolation of Rhizobium from root nodules. (Major)
7. Enumeration of phytoplankton by haemocytometer.
8. Study of bacterial motility by hanging drop method. (Major)

Scheme of practical examination as per Paper 1 practical.

COURSE OUTCOMES

After completing this course students will be able to

Sr. No.	Course outcome
1.	Acquire basics and importance of Microbiology
2.	Learn about basic characteristics features of microorganisms
3.	Describe the classification of Bactria
4.	Gain insights into the important characters, classification & life cycle of viruses.

B. Sc. Semester-II

Discipline Specific Core Course (DSC-4)-MICROBIOLOGY - Paper-IV

(BMI1T04)

(CHEMISTRY OF BIOMOLECULES)

DSC - 4 THEORY	**Hours: 2+2=04 Hours /Week**	**Marks: 80 + 20 = 100**	**Credit: 2+1=03**
	Unit-I		
Carbohydrates and Lipids	1. Classification of carbohydrates, 2. Structure of glucose, fructose, maltose, lactose, sucrose, raffinose, starch, hyaluronic acid, glycogen, cellulose, osazone formation 3. Classification of lipids, structure of triglyceride, compound lipids, derived lipids		**7 Hrs**
	Unit-II		
Amino acids and proteins	1. Classification of amino acids, 2. Titration curve, acidic, basic and neutral amino acids, 3. Peptide bond theory, 4. Organizational levels of proteins, 5. Concept of oligomeric protein		**7 Hrs**
	Unit III		
Enzymology	1. Definitions and nature of enzymes, classification, nomenclature, 2. Primary concept of enzyme kinetics, MM equation, modifications of MM equations, 3. Activation energy, transition state, ES complex, enzyme activity, katal, specific activity ,turnover number 4. Allosteric sites, allosteric modulaters, 5. Functional diversity such as holoenzyme, apoenzyme, coenzyme, cofactor, prosthetic group, isoenzymes, 6. Membrane bound enzymes, multienzyme complex, zymogens		**8 Hrs**
	Unit IV		
Nucleic acid and Vitamins	1. Structure of purines, pyrimidines, nucleosides, nucleotides, 2. Structure of DNA, RNA, and various forms of DNA 3. Types of vitamins, Classification on the basis of solubility, functions of vitamins, 4. Hypervitaminosis – Definition, causes, symptoms, treatment of Vit. A and D 5. Hypovitaminosis – Definition, causes, symptoms, treatment of Vit. B12, A and D		**8 Hrs**

Reference Books:

1. Lehninger. Principles of Biochemistry. 4th Edition. D. Nelson and M. Cox. W.H. Freeman and Company. New York2005
2. Microbiology an Introduction. 6th Edition. Tortora, Funke and Case. Adisson Wesley Longman Inc. 1998.
3. Prescott, Hurley. Klein-Microbiology, 5th & 6thedition, International edition 2002 & 2006, McGraw Hill.
4. Garrett, R. H. and Grisham, C. M. (2004) Biochemistry. 3rd Ed. Brooks/Cole Publishing
   Company, California.
5. Conn Eric, Stumpf Paul K., Bruuening George, Doi Roy H., (1987) Outlines of Biochemistry 5th Ed , John Wiley and Sons, New Delhi.
6. Miller A. D. and Tanner J. (2013). Essentials of Chemical Biology: Structure and Dynamics of Biological Macromolecules. Germany: Wiley.
7. Powar C. B. and Daginawala H. I. (2005). General microbiology Volume I. Himalaya Publishing House Private Limited, Pune, India.

List of Experiments
Perform at least 5 practical

1. Preparation of normal and molar solutions.
2. Preparation of buffer solutions (any 4)
3. Qualitative detection of carbohydrates.
4. Qualitative detection of Protein or amino acids.
5. Qualitative detection of Lipids
6. Determination of pKa value of amino acid. (Major)
7. Quantitative estimation of DNA by DPA method. (Major)
8. Quantitative estimation of RNA by Orcinol method. (Major)
9. Quantitative estimation of protein by Folin Lowry method (Major)
10. Extraction and detection beta carotene
11. Detection of amylase/lipase/gelatinase. (Major)

Scheme of practical examination as per Paper 1 practical.

COURSE OUTCOMES

After completing this course students will be able to

Sr. No.	Course outcome
1.	Students will learn about different types of biomolecules and their functions.
2.	To categorize on the types of enzymes and their mechanism.
3.	Students will learn about the various diseases due to deficiency of vitamins.

Preparation & Standardization of Laboratory Reagents
Course Code: (BVS2P03)

VSC	Hours: 04 Hours /Week	Marks: SEE= 50 CIE= 50	Credit: 02

60 Hrs

LIST OF EXPERIMENTS
(Perform at least 10 practical)

1. Preparation of standard Molar solution of Glucose
2. Preparation of standard Molar solution of Glycine
3. Preparation of standard Molar solution of NaoH and its standardization
4. Preparation of standard Molar solution of HCL and its standardization
5. Preparation of working standard molar solution from stock standard molar solution
6. Preparation of physiological saline solution
7. Preparation of standard buffer solution. Exa. Phosphate buffer and carbonate buffer
8. Preparation of standard normal solution of Bicarbonate and its standardization
9. Preparation of standard normal solution of acetic acid and its standardization
10. Preparation of Leishman stain
11. Preparation of crystal violet solution
12. Preparation of Lugol's iodine
13. Preparation of malachite green solution for spore staining

Scheme of Practical Examination:

4. Two long expt.----------. 15 Marks each
5. Viva-voce---------- 10 Marks
6. Record---------- 10Marks

Total Marks = 50

Reference Books:

1. Plummer, David T. Introduction to Practical Biochemistry, Tata McGraw-Hill Publishing New Delhi
2. Praful B. Godkar and Darshan P Godkar, 2011, Textbook of Medical Laboratory Technology 2nd edition, Bhalani publishing house, Mumbai
3. **Thimmaiah S.K.**, **Standard Methods of** Biochemical **Analysis,** Kalyani Pub.
4. Victor W. Rodwell, David Bender, **Harper**'s Illustrated **Biochemistry** Thirty-First Edition
5. Indian Pharmacopoeia Commission (IPC)

Course outcomes

After this course the students will be able to

Sr. No.	Course outcome
1.	Student will learn the basic knowledge of solution and reagents preparation.
2.	The knowledge is very useful for opting job in industries.

SEM 2 : CONSTITUION OF INDIA (BVE2T02)

Syllabus

UNIT – I:

- Historical Background to the Framing of the Indian Constitution: General Idea about the Constituent Assembly of India.

UNIT – II

- Preamble – Nature and key concepts/Constitutional values, Socialism, Secularism, Democracy, Justice, Liberty, Equality and Fraternity

- Salient Features of the Constitution of India

UNIT – III

- General study about the kinds, nature and importance of; Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

UNIT –IV

Introduction of the Constitutional Institutions and Authorities;

- Central Legislature and Executive (Parliament of India, President of India and Council of Ministers)
- State Legislature and Executive (State legislative Assemblies, Governors and Council of Ministers)
- Higher Judiciary (Supreme Court of India and High Courts)

Indian Knowledge System (IKS)

SEM2: INDIAN ASTRONOMY (BIK2T02)

Course Outcomes: This course will enable the students to understand that

1. It is possible to create a map of the intellectual growth of a culture usingastronomy as a probe.
2. The growth of Indian astronomy occurs in distinct stages analogous to phasetransitions of the evolution of cultures
3. Indian Astronomy therefore provides an excellent window to the pastdramatic transitions.

UNITS	TOPICS	HOURS
Unit 1	Astronomy in Prehistoric Era, Astronomy in Vedic Era, Vedang Jyotish, Astronomical References In Religious Scriptures, Astronomies of the West	**8**
Unit 2	Arya Bhatta, Panch Siddhantika of Varahamihira, Surya Siddhanta Varahamihira to Bhaskar Acharya-II, Siddhant Shiromani of Bhaskar Acharya-II, Bhaskar Acharya-II to Jai Singh, Jai Singh and his Observatories.	**8**
Unit 3	After Jai Singh, Interaction with the Astronomies of the World, Modern Era Astronomy , Our Universe, Cosmology	**7**
Unit 4	Panchang Horoscope and Astrology , Siddhantas, Karnas and Koshtakas, Observational Instruments of Indian Astronomy	**7**
	TOTAL	**30 HRS**

Reference Books:

1. The Story Of Astronomy In India, Chander Mohan, Pothi.com
2. Indian Astronomy: An Introduction. Front Cover · S. Balachandra Rao.Universities Press, 2000
3. Astronomy in India: A Historical Perspective, Thanu Padmanabhan,Springer Science & Business Media
4. Hindu Astronomy, W. Brennand, Alpha Editions
5. Origin and Growth of Astronomy in India, https://www.tifr.res.in/~archaeo/FOP/FOP%20pdf%20of%20ppt/Vahia%20Origin% 20of%20Astronomy.pdf