SRI SANKARA ARTS & SCIENCE COLLEGE

(AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

(CHOICE BASED CREDIT SYSTEM)

B.SC., DEGREE COURSE IN MICROBIOLOGY

(for the candidates admitted from the academic year 2017-2018)

REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the Degree of Bachelor of Science courses shall be required to have passed the Higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an Examination. Provided that candidates for admission into the specific main subject of study shall be Possess such other qualifying conditions as may be prescribed by the University as given in the **APPENDIX-A.**

2. ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if he /she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than three academic years, passed the examinations all the Six-Semesters prescribed earning 140 Credits (in Parts-I, II, III, IV & V).

3. DURATION:

a) Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters, the second academic year the third and fourth semesters and the third academic year the fifth and sixth semester respectively.

b) The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester.

4. COURSE OF STUDY:

The main Subject of Study for Bachelor Degree Courses shall consist of the following and shall be in accordance with **APPENDIX-B**

5. EXTENTION ACTIVITIES:

A candidate shall be awarded a maximum of 1 Credits for Compulsory Extension Service.

All the Students shall have to enrol for NSS /NCC/ NSO (Sports & Games) Rotract/ Youth Red cross or any other service organizations in the college and shall have to put in Complusory minimum attendance of 40 hours which shall be duly certified by the Principal of the college before 31st March in a year. If a student LACKS 40 HOURS ATTENDANCE in the First year, he/she shall have to compensate the same during the subsequent years.

Students those who complete minimum attendance of 40 hours in One year will get HALF A CREDIT and those who complete the attendance of 80 or more hours in Two Years will ONE CREDIT.

Literacy and population Education Field Work shall be compulsory components in the above extension service activities.

6. SCHEME OF EXAMINATION:

Scheme of Examination shall be given in **APPENDIX - C**

The following procedure to be followed for Internal Marks:

Theory Papers: Internal Marks 25

INTERNAL MARKS

Tests (2 out of 3)	= 10
Attendance	= 5

Seminars	= 5
Assignments	= 5

	25marks

Break-up Details for Attendance

Below 60%	- No marks
60% to 75%	- 3 marks
76% to 90 %	- 4 marks
91% to 100%	- 5 marks

Practical:	Internal Marks	40		
	Attendance	5 marks		
	Practical Test best 2 out of 3	30 marks		
	Record	5 marks		
Project:	**Internal Marks**	Best	2 out of 3 presentations	20 marks
Project Report		80 marks		

7. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER:

i. Candidates shall register their names for the First Semester Examination after the admission in UG Courses.

ii. Candidates shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subject of earlier semesters along the current (subsequent) Semester Subjects.

iii. Candidates shall be eligible to go to subsequent semester, only if they earn sufficient attendance as prescribed there for by the college from time to time.

Provided in case of a candidate earning less than 50% of attendance in any one of the Semesters due to any extraordinary circumstances such as medical grounds, such candidates who shall produce Medical Certificate

issued by the Authorized Medical Attendant (AMA), duly certified by the Principal of the college, shall be permitted to proceed to the next semester and to complete the Course of study. Such Candidates shall have to repeat the missed Semester by rejoining after completion of Final Semester of the course, after paying the fee for the break of study as prescribed by the College from time to time.

8. PASSING MINIMUM:

A candidate shall be declared to have passed:

a) There shall be no Passing Minimum for Internal.

b) For External Examination, Passing Minimum shall be of 40% (Forty Percentage) of the maximum marks prescribed for the paper for each Paper/Practical/Project and Viva-voce.

c) In the aggregate (External + Internal) the passing minimum shall be of 40%.

d) He/She shall be declared to have passed the whole examination, if he/she passes in all the papers and practicals wherever prescribed / as per the scheme of examinations by earning 140 CREDITS in Parts-I, II, III, IV & V. He/she shall also fulfill the extension activities prescribed earning a minimum of 1 Credit to qualify for the Degree.

9. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

PART- I TAMIL / OTHER LANGUAGES

TAMIL/OTHER LANGUAGES: Successful candidates passing the Examinations for the Language and securing the marks (1) 60 percent and above and (ii) 50 percent and above but below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND class, respectively. All other successful candidates shall be declared to have passed the examination in the THIRD Class.

PART – II ENGLISH

ENGLISH: Successful candidates passing the examinations for English and securing the marks (i) 60 percent and above and (ii) 50 percent and above but

below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND Class, respectively. All other successful candidates shall be declared to have passed the examination in the THIRD class.

PART – III consisting of CORE SUBJECTS, ALLIED SUBJECTS, PROJECT / ELECTIVE with three courses:

Successful candidates passing the examinations for Core Courses together and securing the marks (i) 60 percent and above (ii) 50 percent and above but below 60 percent in the aggregate of the marks prescribed for the Core courses together shall be declared to have passed the examination in the FIRST and SECOND Class respectively. All other successful candidates shall be declared to have passed the examinations in the Third Class.

PART – IV (consisting of sub items 1 (a), (b) & (c), 2, 3 and 4) as furnished in the Regulations 4 Part-IV supra.

PART – V EXTENTION ACTIVITIES**:**

Successful Candidate earning of 1 credit SHALL NOT BE taken into consideration for Classification/Ranking/ Distinction.

10. RANKING:

Candidates who pass all the examinations prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for Ranking/ Distinction.

Provided in the case of Candidates who pass all the examinations prescribed for the Course with a break in the First Appearance due to the reasons as furnished in the Regulations. 7 (iii) supra are only eligible for classification.

11. TRANSITORY PROVISION:

Candidates who have undergone the course of study prior to the academic year 2014 – 2015 will be permitted to appear for the examinations under those Regulations for a period of TWO years i.e. up to and inclusive of April/May 2018 Examinations. Thereafter, they will be permitted to appear for the examination only under the Regulations then in force.

Question Paper Pattern

SECTION – A (30 words)			
10 OUT OF 12	-	10 X 2 marks	= 20 marks
SECTION – B (200 words)			
5 out of 7	-	5 x 5 marks	= 25 marks
SECTION – C (500 words)			
3 out of 5	-	3x 10 marks	= 30 marks

		TOTAL	**= 75 marks**

QUESTION PAPER FOR PRACTICALS

The external examiner will prepare a question paper on the spot with the help of the Question Bank supplied by the Controller's office.

APPENDIX – A

ADDITIONAL ELIGIBILITY CONDITIONS FOR ADMISSION TO THE FOLLOWING COURSE

(1) CANDIDATES FOR ADMISSION TO THE FOLLOWING COURSES SHALL HAVE PASSED THE QUALIFYING EXAMINATION WITH THE SUBJECTS NOTED AGAINST EACH:

(i) MICROBIOLOGY : ANY SCIENCE GROUP

APPENDIX - B

PART – I TAMIL / OTHER LANGUAGES

PART – II ENGLISH

PART – III CORE SUBJECTS

ALLIED SUBJECTS

PROJECT/ELECTIVES WITH THREE COURSES

PART – IV

1.(a) Those who have not studied Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Tamil comprising of two course (level will be at 6^{th} Standard).

(b) Those who have studies Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Advanced Tamil comprising of two courses.

(c) Others who do not come under a + b can choose non-major elective comprising of two courses.

2. SKILL BASED SUBJECTS (ELECTIVE) - (SOFT SKILLS)

3. ENVIRONMENTAL STUDIES

4 VALUE EDUCATION

PART – V EXTENSION ACTIVITIES

APPENDIX – C

Model Scheme

Course Component **Name of the course**	**Inst. Hour**	**Credits**	**Exam Hours**	**Max. Marks**		
				Ext. mark	**Int. mark**	**Total**
PART-I Language				**75**	**25**	**100**
PART-II English				**75**	**25**	**100**
PART-III Core subject :				**75**	**25**	**100**
Core Subject				**75**	**25**	**100**
Allied Subject				**75**	**25**	**100**
PART – IV 1.(a) Those who have not studied Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Tamil comprising of two course (level will be at 6th Standard). (b) Those who have studies Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Advanced Tamil comprising of two courses. (c) Others who do not come under a + b can choose non-major elective comprising of two courses.						
2*Skill based subjects(Elective) – (Soft Skill)						

COURSE CONTENT FOR B.SC., DEGREE COURSE IN MICROBIOLOGY

FIRST SEMESTER

S. No	Course component	Name of course	Inst. hours	Credits	Exam hour	Theory/Practical (External **:** Internal)	Max. Marks
1	Part I	Language/ Tamil Paper I	4	3	3	75 : 25	100
2	Part II	English Paper I	4	3	3	75 : 25	100
3	Part III	Core Theory Paper I- **General Microbiology and Microbial Physiology**	6	4	3	75 : 25	100
4	Part III	**Core**: Paper I: *Practical: **General Microbiology and Microbial Physiology**	3	4	6	60 : 40	100
5	Part III	**Allied** :Paper I: **Allied Biochemistry I**	6	4	3	75 : 25	100
6	Part III	*Allied Practical I – **Allied Biochemistry I**	3	**Examination will be held in Semester II**			

7	Part IV	**1.a.** Those who have not studied Tamil upto XII std and taken a non-tamil language under Part – I shall take Tamil comprising of two courses (level will be at 6^{th} std). **b.** Those who have studied Tamil upto XII std and taken a non-Tamil language under Part- I shall take Advanced Tamil comprising of two courses. **c.** Others who do not come under a+b can choose non- major elective comprising of two courses.	2	2	3	75 : 25	100
8		**Skill based subject :** Soft skill I	2	2	3	50 : 50	100
Total credit: 22							

SECOND SEMESTER

S. No	Course component	Name of course	Inst. hours	Credits	Exam hour	Theory/Practical External : Internal	Max. marks
1	Part I	Language/ Tamil Paper II	4	3	3	75 : 25	100
2	Part II	English Paper II	4	3	3	75 : 25	100
3	Part III	**Core**: Paper II: **Immunology**	6	4	3	75 : 25	100
4	Part III	***Core**: Practical II : **Immunology**	3	4	6	60 : 40	100
5	Part III	Allied Paper II – **Allied Biochemistry II**	6	4	3	75 : 25	100
6	Part III	***Allied** :Practical II: **Allied Biochemistry I and II**	3	4	3	60 : 40	100
7	Part IV	**1. a.** Those who have not studied Tamil up to XII std and taken a non- tamil language under Part – I shall take Tamil comprising of two courses (level will be at 6^{th} std). **b.** Those who have studied Tamil up to XII std and taken a non- Tamil language under Part- I shall take Advanced Tamil comprising of two courses. **c.** Others who do not come under a+b can choose non-	2	2	3	75 : 25	100

		major elective comprising of two courses.					
8	Part IV	**Skill based subject :** Soft skill II	2	2	3	50 : 50	100
Total credit: 26							

THIRD SEMESTER

S. No	Course component	Name of course	Inst. hours	Credits	Exam hour	Theory/ Practical External : Internal	Max. Marks
1	Part I	Language/ Tamil Paper III	4	3	3	75 : 25	100
2	Part II	English Paper III	4	3	3	75 : 25	100
3	Part III	**Core**: Paper III: **Molecular Biology**	6	4	3	75 : 25	100
4	Part III	**Core**: *Practical III : **Molecular Biology**	3	4	6	60 : 40	100
5	Part III	Allied Paper III – **Bioinstrumentation**	6	4	3	75 : 25	100
6	Part III	***Allied** :Practical III: **Bioinstrumentation**	3	4	3	60 : 40	100
7	Part IV	**Skill based subject :** Soft skill III	2	2	3	50 : 50	100
Total credit: 24							

FOURTH SEMESTER

S. No	Course component	Name of course	Inst. hours	Credits	Exam hour	Theory/ Practical External : Internal	Max. marks
1	Part I	Language/ Tamil Paper IV	4	3	3	75 : 25	100
2	Part II	English Paper IV	4	3	3	75 : 25	100
3	Part III	**Core**: Paper IV: **Soil and Agricultural Microbiology**	6	4	3	75 : 25	100
4	Part III	**Core**: *Practical IV : **Soil and Agricultural Microbiology**	3	4	6	60 : 40	100
5	Part III	Allied Paper IV – **Biostatistics**	6	4	3	75 : 25	100
6	Part III	***Allied** :Practical IV: **Biostatistics**	3	4	3	60 : 40	100
7	Part IV	**Skill based subject :** Soft skill IV	2	2	3	50 : 50	100
8	Part IV	**Environmental Studies**	2	2	3	75 : 25	100
Total credit: 26							

FIFTH SEMESTER

S. No	Course component	Name of course	Inst. hours	Credits	Exam hour	Theory/ Practical External : Internal	Max. marks
1	Part III	**Core**: Paper V: **Medical Bacteriology**	5	4	3	75 : 25	100
2	Part III	**Core**: Paper VI: **Medical Mycology & Parasitology**	5	4	3	75 : 25	100
3	Part III	**Core**: Paper VII: **Medical Virology**	5	4	3	75 : 25	100
4	Part III	**Core**: *Practical V : **Bacteriology, Mycology, Parasitology & Virology**	5	4	6	60 : 40	100
5	Part III	Elective I : **Microbial Genetics and Genetic Engineering**	4	3	3	75 : 25	100
6	Part III	Elective II : **Industrial and Pharmaceutical microbiology**	4	3	3	75 : 25	100
7	Part IV	**Value education**	2	2	3	75 : 25	100
Total credit: 24							

SIXTH SEMESTER

S. No	Course component	Name of course	Inst. hours	Credits	Exam hour	Theory/ Practical External : Internal	Max. marks
1	Part III	**Core**: Paper VIII: **Environmental Microbiology**	6	4	3	75 : 25	100
2	Part III	**Core**: Paper IX: **Food & Dairy Microbiology**	6	4	3	75 : 25	100
3	Part III	***Core**: Practical VI : **Environmental, Food & Dairy Microbiology**	5	4	6	60 : 40	100
4	Part III	**Core**: **Research Project**	8	2	3	80 : 20	100
5	Part III	**Elective**: Paper III: **Biotechnology**	5	3	3	75 : 25	100
6	Part V	**Extension activities**	-	1			
Total credit: 18							

*** Practical Examinations will be conducted in even semester only.**

SYLLABUS FOR B.SC. DEGREE COURSE IN MICROBIOLOGY

FIRST SEMESTER

CORE – I THEORY : GENERAL MICROBIOLOGY & MICROBIAL PHYSIOLOGY

UNIT I

History of microbiology, Scope and relevance of Microbiology, Microscopy including electron microscope; stains and staining methods. Anatomy of prokaryotic and eukaryotic cells.

UNIT II

Culture media and pure culture techniques. Anaerobic culture techniques. Sterilization and disinfection; Antimicrobial chemotherapy.

UNIT III

Methods of bacterial identification- morphological, physiological, biochemical, Molecular taxonomical and serological properties.

UNIT IV

Physiology of microbial growth and nutrition. Batch – continuous - synchronous cultures; Growth Curve. Nutritional requirements. Transport of nutrients by active and passive transport. Sporulation.

UNIT V

Respiration. Fermentation. Photosynthesis - oxygenic and anoxygenic.; Bio-geo chemical cycles. Distribution of Algae - Thallus structure in algae - Reproduction in alga - Life cycle patterns in algae

References:

1. Gerard J. Tortora, Berdell R. Funke, Christine L. Case (2015) Microbiology: An Introduction (12th Edition).PEARSON, London, United Kingdom
2. Joanne Willey and Linda Sherwood (2013) Prescott's Microbiology, McGraw-Hill Education; 9 edition (January 8, 2013). ISBN-10: 0073402400

3. Bernard D. Davis. Renato Dulbecco. Herman N. Eisen.and Harold, S. Ginsberg. (1990).Microbiology (4th edition). J.B.Lippincott company, New York.
4. Alexopoulus C.J. and C W. Mims.(1993). Introductory Mycology(3rd edition).Wiley Eastern Ltd, New Delhi.
5. Elizabeth Moore - Landecker. (1996). Fundamentals of the fungi. (4th edition). Prentice Hall International, Inc, London.
6. Heritage,J. Evans E.G.V. and Killington, R.A. (1996). Introductory Microbiology. Cambridge University Press.
7. Holt, J.S., Kreig, N.R., Sneath, P.H.A and Williams, S.T. Bergey's Manual of Determinative Bacteriology (9th Edition), Williams and Wilkins, Baltimore.
8. John Webster (1993). Introduction to Fungi. (2nd edition).Cambridge University press, Cambridge.
9. Prescott L.M. Harley J.P. and Klein D.A. (2003). Microbiology (5th edition) McGraw Hill, New York.
10. Larry Mc Kane.and Judy Kandel (1996). Microbiology-Essentials and applications. (2nd edition). Mc Fraw Hill Inc, Newyork.
11. Madigan, M.T. Martinko.J.M and Parker J Brock T.D. (1997). Biology of Microorganisms.(8th edition).Prentice Hall International Inc, London.
12. Schaechter M and Leaderberg J (2004). The Desk encyclopedia of Microbiology. Elseiver Academic press, California.
13. Nester, E.W., Roberts, C.V. and Nester, M.T. (1995). Microbiology, A human perspective. IWOA, U.S.A.
14. Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology, Mc. Graw Hill. Inc, New York.
15. Salle, A.J. (1996). Fundamental principles of Bacteriology.(7th edition).Tata McGraw - Hill publishing company Ltd, New Delhi.
16. Caldwell, D.R. (1995). Microbial Physiology and metabolism, Wm. C. Brown Publishers, U.S.A.
17. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2003). Microbiology.(5th edition). McGraw - Hill company, New York.

18. White, D. (1995). The physiology and biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
19. Prescott, L.M., Harley, J.P. and Klein, D.A. (1999) Microbiology. McGraw Hill, New Delhi
20. Mandelstam, J., McQuillen, K. and Dawes, L. (1992) Biochemistry of Bacterial Growth, 3rd Edn. Blackwell Scientific Publications, Oxford.
21. Moat, A.G. and Foster, J.W. (1995) Microbial Physiology, 3rd Edn. John Wiley and Sons, New York.
22. Ingraham, J.L. and Ingraham, C.A. (2000) Introduction to Microbiology, 2nd Edn. Books / Cole Thomson Learning, UK.
23. Schelegel, H.G. (1993) General Microbiology,7th Edn. Cambridge University Press, Cambridge.

CORE- I PRACTICAL: GENERAL MICROBIOLOGY AND MICROBIAL PHYSIOLOGY

UNIT I

Cleaning of glass wares Sterilization principle and methods- moist heat- dry heat and filtration methods. Media preparation: liquid media, solid media, agar slants, agar plates, basal, enriched, selective media preparation- quality control of media, growth supporting properties, sterility check of media.

UNIT-II

Pure culture techniques: streak plate, pour plate, decimal dilution. Culture characteristics of microorganisms: growth on different media, growth characteristics and description. Demonstration of pigment production.

UNIT-III

Microscopy: light microscopy, bright field microscopy, dark field microscopy. Motility demonstration: hanging drop, wet mount preparation, dark field microscopy, semi solid agar, Craigie's tube method. Staining techniques: smear preparation, simple staining, Gram's staining, acid fast staining, staining of Metachromatic granules, Endospore and capsular Staining.

UNIT-IV

Morphology of microorganisms: morphological variations in algae, morphology of

fungi, slide culture technique. Antibiotic sensitivity testing: Disc diffusion test-quality control with standard strains. Micrometry: Demonstration of size of yeast and fungal filaments.

UNIT-V

Physiology characteristics: IMViC test, H2S, Oxidase, catalase, urease test. Carbohydrate fermentation test, maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

ALLIED PAPER I – THEORY - BIOCHEMISTRY - I

UNIT I

Definition and classification of carbohydrates, linear and cyclic forms (Haworth projection) for glucose, fructose and mannose and disaccharides (maltose, lactose, sucrose).

UNIT II

General properties of monosaccharides and disaccharides. Occurrence and significance of polysaccharides.

UNIT III

Amino acids, various classifications, amphoteric nature, isoelectric point. Reactions of carboxyl and amino groups.

UNIT IV

Proteins- classification - biological functions, physical properties- ampholytes, isoionic point, salting in and salting out, denaturation, nature of peptide bond. Secondary structure, α-helix and β-pleated sheet, tertiary structure, various forces involved- quaternary structure. Deamination, transamination and urea cycle.

Books Recommended

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6^{th} ed) W.H. Freeman.

2. Voet.D & Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.

3. Lubert Stryer (2010) Biochemistry,(7^{th} ed), W.H.Freeman

4. Satyanarayan,U (2014) Biochemistry (4th ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.
5.Jain J.L.(2007) Fundamentals of Biochemistry,S.Chand publishers

SECOND SEMESTER

CORE PAPER-II –THEORY: IMMUNOLOGY

UNIT-I

History of Immunology - Immunohaematology. Blood groups - Blood transfusion - Host parasite relationships. Microbial infections.

UNIT-II

Structure and function of the cells, tissues and organs of immune system. Types of immunity - Humoral and cell-mediated, innate, acquired immunity. Complement system - function and pathways.

UNIT-III

Antigen - types, properties. Hapten, adjuvants, Immunoglobulins: Structure types properties and their function - Theory of antibody production.

UNIT-IV

Vaccines and Immunization - Types and their characteristics. Monoclonal Antibody - Hybridoma Technology. Cell mediated immune response - Lymphokines, Cytokines.

UNIT-V

Antigen-antibody interaction *in-vitro* Agglutination, complement fixation, Precipitation, ELISA, RIA, Flow cytometry and Fluorescence immunoblotting – Hypersensitivity. Skin tests, Autoimmunity, Transplantation Immunology: Immunologic basis of graft rejection- Autograft, Isograft, Allograft, and Xenograft.

References:

1. Kuby, J. (1994) Immunology, 2nd Edn. H.W.Freeman and Company, New York.
2. Elgert, K.D. (1996) Immunology:Understanding the Immune System. Wiley – Liss, New York.
3. Donald M. Weir, John Steward. (1993). Immunology VII edition. ELBS, London.
4. Hue Davis (1997). Introductory Immunology (First Edition). Chapman & Hall Publisher, London.
5. Ivan M. Roit. (1994) Essential Immunology – Blackwell Scientific Publications, Oxford.
6. Paul (1998). Fundamental Immunology, II Edition, Raver Press, New York.
7. Peter J. Delves, Ivan M. Roit (eds) (1998) Academic Press – Encyclopedia of Immunology – 2nd edition.
8. Ridklad, M. Aydl (1995). Immunology, II Edition, Baltimore, Hong Kong, NMS Publication.
9. Roit, J.M. Brostaff, J.J. and Male, D.K. (1996). Immunology (4th Edition) C.V. Mosby Publisher, St. Loius.
10. Jacqucline S, Williams and Wilkins A. (1998) Basic Immunology - Warerly Company.
11. Janeway Travers. (1997). Immuno biology - The immuno system in health and Disease. 3rd edition Current Biology Ltd., London, New York.
12. Lydyard P, Whelan A and Fanzer MW (2000) Instant notes in Immunology, Edited By Hames BD, Viva Books Private Ltd.
13. Mark Reakman Diego Vergani. Basic and clinical immunology, Longman Asia Ltd., Hong kong.
14. Richard M. Hyde. (1995). Immunology III edition. National Medical series, Williams and Wilkins, Harward Publishing Company.
15. Clark WR (1991). The experimental foundations of modern immunology, John Wiley and Sons Inc. New York.

16. Hudson L and Henry FC (1999) Practical Immunology, 3rd edition, Blackwell Scientific Publishers, Oxford, London.
17. Miller L.E, Luke H.R, Peacock J.E and Tomar R.H (1990). Manual of Laboratory Immunology, 2nd edition, Lea and Febiger - London.

CORE II- PRACTICAL: IMMUNOLOGY

UNIT-I

Blood groups and typing - Coombs's test. Precipitation reaction in Gel-Outchelony double diffusion, Single Radial Immuno diffusion.VDRL, RPR. Agglutination reactions: Slide and Tube methods RBC agglutination IHA, TPHA Bacterial.

UNIT-II

Complement fixation test. Titration of amboceptor and complement (demonstration only). Immunofluorescene, (Demonstration only), ELISA

UNIT-III

Isolation of Buffy coat, using heparin lymphocytes (T cells, B cells), Enumeration of different cell types, Perpheral blood cell counts, absolute cell counts.

UNIT-IV

Antibody productions in rabbits against sheep RBC and its titration (Demonstration). Anaphylactic reactions in guinea pigs. Arthus reaction in rabbits, (Demonstration).

UNIT-V

Skin tests, both immediate and delayed hypersensitivity reactions to egg proteins, bacterial, fungal antigens.

ALLIED- II- Paper I- BIOCHEMISTRY- II

UNIT I

Fats - function, classification, simple lipids, fatty acids (saturated and unsaturated), compound lipids, derived lipids, properties- saponification, rancidity, reduction, oxidation, halogenation. Functions of phospholipids, Cholesterol – biological importance, chemical properties.

UNIT II

Purine and pyrimidine bases, nucleosides, nucleotides, polynucleotides, DNA structure, various types, properties- absorbance, effect of temperature. Different types of RNA, structure and function, Genetic code.

UNIT III

Enzymes - definition, units of enzyme activity, enzyme nomenclature, specificity, isoenzymes, factors affecting enzyme activity- substrate concentration, pH, temperature. Michaelis and Menten equation. Lineweaver- Burk plot, Enzyme inhibition, competitive, uncompetitive and and non competitive inhibition

UNIT IV

Vitamins, definition, classification, water soluble vitamins, B1, B2, B3, B6, B12 and Vitamin C. Deficiency diseases. Fat soluble vitamins- A, D, E and K- Deficiency diseases.

Books Recommended:

1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6^{th} ed) W.H. Freeman.

2. Voet.D & Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.

3. Lubert Stryer (2010) Biochemistry,(7^{th} ed), W.H.Freeman

4. Satyanarayan,U (2014) Biochemistry (4^{th} ed), Arunabha Sen Books & Allied (P) Ltd, Kolkata.

5.Jain J.L.(2007) Fundamentals of Biochemistry,S.Chand publishers

ALLIED- I & II- BIOCHEMISTRY PRACTICALS (I & II)

1. Volumetric analysis
    a. Estimation of ascorbic acid using 2,6 – dichlorophenol indophenol as link solution.
    b. Estimation of calcium in milk.
2. Qualitative analysis
    a. Qualitative analysis of carbohydrates- glucose, fructose, galactose, lactose, maltose and sucrose.
    b. Qualitative analysis of amino acids – arginine, cysteine, tryptophan and tyrosine.
3. Quantitative analysis: (demonstration)
    a. Colorimetric estimation of protein by Biuret method.
    b. Colorimetric estimation of phosphorus.
4. Biochemical preparations
    a. Preparation of casein from milk.
    b. Preparation of starch from potato.

References:

1. Practical Clinical Biochemistry - Harold Varley, CBS, New Delhi.
2. Medical Laboratory Technology-Kanai L. Mukherjee, Tata McGraw Hill., Vol. I, II, III.
3. Clinical Chemistry - Ranjana Chawla.
4. Laboratory manual in Biochemistry - Jayaraman.
5. Biochemical methods - S.Sadasivan and Manickam.
6. Introduction to Practical Biochemistry - David T. Plummer

THIRD SEMESTER

CORE III THEORY: MOLECULAR BIOLOGY

UNIT I

DNA structure, various forms (A, B, Z & H), Stability of nucleic acid structures; prokaryotic and eukaryotic genome organizations.

UNIT II

DNA replication, repair and recombination:, Enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.

UNIT III

RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, Regulation of transcription factor activity, RNA polymerases, capping, elongation and termination, Regulation of mRNA processing, processing of rRNA and tRNA RNA editing, splicing, polyadenylation, structure and function of different types of RNA.

UNIT IV

Protein synthesis: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, inhibition factors of protein synthesis, genetic code, aminoacylation of tRNA,

UNIT V

Control of gene expression at transcription and translation level: Regulation of, prokaryotic and eukaryotic gene expression, role of chromatinin regulating gene expression and gene silencing.

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20. Macinski, G.M. and Freifelder, D. (1998). Essentials of Molecular Biology, 3rd Edition, John and Bartlett Publishers.
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24. Surzyeki S (2000). Basic Techniques in Molecular Biology. Springer.
25. Miyamoto MM, Cracraft JL. Phylogenetic Analysis of DNA sequences. Oxford University Press. Oxford.
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30. Lewin B. (2000). Genes VII. Oxford University press
31. Maloy SR, Cronan Jr. JE, Freifelder D (1994). Microbial genetics. Jones and Bartlett publishers.
32. Singer M, Berg P. (1991). Genes and Genomes. University Science Books.
33. Balows A, Hansler Jr K.L, Isenberg H.D, Shalomy H.J (1991). Manual of Clinical Microbiology, American Society for Microbiology, Washington DC.

CORE III PRACTICAL: MOLECULAR BIOLOGY

UNIT I

Estimation of DNA by diphenylamine method. Estimation of RNA by orcinol method.

UNIT II

Isolation of Plasmid DNA by Alkalysis method. Isolation of genomic DNA from prokaryotes. Isolation of Chromosomal DNA from Eukaryotic cells. Eg. Leaves,.

UNIT III

Isolation of RNA from yeast.

Isolation of antibiotic resistant mutants.

UNIT IV

Preparation of competent cells.

UNIT V

Transformation of *E.coli.*

ALLIED III THEORY: BIOINSTRUMENTATION

UNIT I

Basic laboratory Instruments

Common laboratory equipment –anaerobic incubator – Biosafety Cabinet - Principle and working of pH meter, Laminar-air flow. Centrifugation: Types & principles and their applications- Lyophilizer - Flow cytometry.

UNIT II

Chromatographic techniques

Theory, principles and applications of paper, thin layer, gel filtration, ion exchange,

UNIT III

Electrophoretic techniques

Basic principles of electrophoresis, theory and application of paper, agarose,

UNIT IV

Spectroscopy

Spectroscopic techniques, theory and applications of UV, Visible, NMR, Fluorescence, CD, ORD.

UNIT V

Radioisotopic techniques

Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, autoradiography and its applications.

ALLIED III – Paper II

PRACTICAL III (BIOINSTRUMENTATION)

1. Studies on pH titration curves of amino acids/ acetic acid and determination of pKa

values and Handerson-Hasselbach equation.

2. Separation of bacterial lipids/amino acids/sugars/ by TLC or Paper

Chromatography.

3. Separation of serum protein by horizontal submerged gel electrophoresis.

4. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial

pigments).

5. Quantitative estimation of hydrocarbons/pesticides/organic

Solvents /methane by Gas chromatography. (Demonstration)

6. Demonstration of PCR, DNA sequencer, Fermenter, Flow cytometry

References

1. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.
2. Gel Electrophoresis of Proteins- A Practical Approach by Hanes.
3. Analytical Biochemistry by Holme.
4. Introduction to High Performance Liquid Chromatography by R R. J. Hamilton and P. A. Sewell.
5. Spectroscopy by B.P. Straughan and S. Walker.

6. John G. Webster. (2004). Bioinstrumentation. University of Wisconsin, John Wiley & Sons, Inc.

FOURTH SEMESTER

CORE IV THEORY : SOIL AND AGRICULTURAL MICROBIOLOGY

UNIT I

Soil microbiology - quantitative and qualitative micro flora of different soils-role of microbes in soil fertility-tests for soil fertility - soil structure, soil formation - characterization of soil types and importance.

UNIT II

Biogeochemical cycles-role of micro organisms in carbon, phosphorus, sulphur and iron cycles. Methods of studying ecology of soil micro organisms-microbial gas metabolism-carbon dioxide, hydrogen, and methane and hydrogen sulphide.

UNIT III

Microbial interactions between microorganisms, plant and soil. Rhizoplane, rhizosphere, phyllosphere, spermosphere, mycorrhizae. Microbial association with insects-gut micro flora - symbiosis between microbes and insects; organic matter decomposition.

UNIT IV

Nitrogen cycle; ammonification- nitrification- de-nitrification- nitrogen fixation-Bio-fertilizers (bacterial, cyanobacteria and azolla), mycorrhiza and its types and crop response-bio-pesticides (bacterial, viral and fungal) saprophytes for pathogen suppression.

UNIT V

Principles of plant infection and defense mechanisms. Symptoms, Etiology, Epidemiology and Management of the following plant diseases: Mosaic disease of tobacco; Bunchy top of banana; Leaf roll of potato; Bacterial blight of paddy;

Angular leaf spot of cotton, Late blight of potato; Damping off of tobacco, downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Blight of maize/sorghum; Leafspot of paddy, Grassy shoot of sugar cane; Root knot of mulberry.

References:

1. P. C. Trivedi (2010) Agricultural Microbiology, Pointer Publishers (January 1, 2010), ISBN-10: 8171326153
2. Eldor A. Paul (2014) Soil Microbiology, Ecology and Biochemistry, Fourth Edition,
3. Atlas, R.M. and Bartha, R. (1992) Microbial Ecology: Fundamentals and Applications, 2nd Edn. The Benjamin / Cummings Publishing Co.,Redwood City,CA.
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11. Somani, L.L., S.C. Bhandari, K.K. Vyas and S.N. Saxena. 1990. Biofertilizers, Scientific Publishers - Jodhpur.
12. Tilak, K.V.B. 1991. Bacterial Biofertilizers, ICAR Pub., New Delhi

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CORE IV –PRACTICAL: SOIL AND AGRICULTURAL MICROBIOLOGY

UNIT I

Methods to study soil microorganisms - Isolation and enumeration of Bacteria, Fungi, Bacterio-phages, Algae, Protozoa etc., Microbiological test for fertility - Bacterial and Fungal

UNIT II

Microbiological demonstration of soil enzymes – Amylase, Protease, Lipase, Gelatinase etc.

UNIT III

Isolation and identification of root nodule bacteria- Rhizobium(symbiotic), demonstration of rhizobium in the root nodule(CS of root nodule) Isolation and identification of Azotobacter (Asymbiotic).

UNIT IV

Isolation and identification of nitrogen fixing Cyanobacteria-Anabaena, Nostoc etc., Demonstration of Azolla Demonstration of antagonistic activity –bacterial and fungal.

UNIT V

Study of the following discases: Tobacco mosaic; Bacterial blight of paddy; Downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Leaf spot of paddy, Red rot of sugar cane, Root knot of mulberry.

ALLIED 4 – THEORY: BIOSTATISTICS

UNIT I

Introduction: Types of biological data; frequency distributions; cummulative frequency distributions.

Populations and samples: Populations; samples from populations; random sampling; parameters and statistics.

UNIT II

Measures of Central Tendency: Mean; median; mode; geometric mean; harmonic mean.

Measures of Dispersion: Range; variance; standard deviation, coefficient of variation; standard error.

UNIT III

Probability: Mathematical probability and statistical probability; Laws of probability; addition law and multiplication law; conditional probability.

Probability Distribution: Normal distribution; binomial distribution and poisson distribution.

UNIT IV

Testing for goodness of fit: Chi-square test for goodness of fit; statistical significance; statistical errors in hypothesis testing; chi-square test for contingency tables; heterogeneity chi-square test.

Test of hypothesis: Normal deviation test, tests for proportions, t-test.

UNIT V

Simple linear regression and correlations:

Simple linear regression; testing the significance of a regression; comparison of two slopes; correlation coefficient – hypothesis testing about correlation coefficients; comparison of two correlation co-efficients; rank correlation; intraclass correlation.

Analysis of variance: One-way classification; two-way classification.

ALLIED 4 PRACTICAL: BIOSTATISTICS

UNIT I

Frequency distribution – Univariate – Bivariate; Measure of central tendency

UNIT II

Measure of dispersion; Correlation, Regression

UNIT III

Fitting distribution – Binomial – Poison – Method of least squares

UNIT IV

Tests of significance – T – F; Tests of significance – Chi-square – Attributes

UNIT V

ANOVA; Design of experiments – CRO, RBD, LSD

References:

1. Arora, P.N. and Malhon P.K., (1996) Biostatistics. Imalaya Publishing House, Mumbai.
2. Sokal and Rohif, Introduction to Biostatistics - Toppan Co. Japan.
3. Stanton, A and Clantz, Primer of Biostatistics - The McGraw Hill Inc., New York.
4. Stanton, A and Clantz, Primer of Biostatistics - The McGraw Hill Inc., New York.

FIFTH SEMESTER

CORE V-THEORY: MEDICAL BACTERIOLOGY

UNIT I

Classification and general properties of medically important bacteria. Recommendation for collection, transport of specimens, isolation of bacteria from clinical specimens. Indigenous normal microbial flora of human body

UNIT II

Primary media for isolation and their quality control - Antibiotic sensitivity testing procedures -Stokes & Kirby Bauer methods - Disc diffusion -Dilution -Agar dilution & broth dilution -MBC/MIC - Quality Control of antibiotics assays

UNIT III

Staphylococcus, Streptococcus, Neisseria, Branhamella Corynebacterium and Mycobacterium - typical and atypical. Aerobic pathogenic actinomycetes.

UNIT IV

Bacillus, Vibrios, Aeromonas Helicobacter, Pseudomonas, Brucella, Haemophilus, Bordettella. Enterobacteriaceae- Salmonella, Shigella, Proteus, Escherichia and Klebsiella.

UNIT V

Clostridia, Mycoplasma, Rickettsiae, Spirochetes, Trepenema, Leptiospira and Borrelia.

References:

1. Patrick R. Murray and Ken S. Rosenthal (2015) Medical Microbiology, Elsevier
2. Joanne Willey and Linda Sherwood (2013) Prescott's Microbiology, McGraw-Hill Education; 9 edition (January 8, 2013). ISBN-10: 0073402400

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6. Lorian, V. (1991) Antibiotics in laboratory medicine, 3rd edition, Williams and Wilkins, Baltimore.
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14. Delbecco, Eisen & Ginsburg (1990) Microbiology 5th Edition Harper & raw, New York
15. Chaechter M. Medoff G. and Eisenstein BC. (1993) Mechanism of Microbial Diseases 2nd edition. Williams and Wilkins, Baltimore.

16. Patrick R. Murray. (editor chief) (1999) Manual of clinical microbiology, 7th edition, ASM Press, Washington D.C.
17. Prakash M., Arora, C.K. (1998) Pathological techniques - Anmol Publications Pvt. Ltd. N.D.
18. Jewetz, E., Melnic, J.L. and Adelberg, E.A. (2000) Review of Medical Microbiology, 19th Edn. Lange Medical Publications, U.S.A.
19. Ananthanarayan, R. and Jeyaram Paniker, C.K. (1994) Text Book of Microbiology, 6th Edn. Orient Longman, Chennai.
20. Jeyaram Paniker, C.K. (2006) Text Book of Parasitology. Jay Pee Brothers, New Delhi.

CORE VI- THEORY: MEDICAL MYCOLOGY AND PARASITOLOGY

UNIT I

Morphology, Taxonomy, Classification of fungi. Characteristics of Zygomycetes, Ascomycetes, Basidiomycetes and Duteromycetes.

UNIT II

Dermatophytes and agents of superficial mycoses. Trichophyton, Epidermophyton and Microsporum. Opportunistic mycoses-Candidiasis, Cryptococcosis, Aspergillosis. Systemic mycoses-Histoplasmosis, Coccidioidomycosis, Blastomycosis. Subcutaneous mycoses- Sporotrichosis, Mycetoma.

UNIT III

ollection, transport of specimens, isolation of fungi from clinical specimens. Newer methods in diagnostic mycology. Mycotoxins, Antifungal agents, testing methods and quality control.

UNIT IV

Introduction to medical Parasitology – Classification, Protozoa – Entameoba – Plasmodium, Leishmania – Trypanosoma –Giardia – Trichomonas – Balantidium.

UNIT V

Platyhelminthes – Taenia – Fasciola – Paragonimus – Schistosoma. Nematihelminthes – Ascaris – Ankylostoma – Enterobius – Trichuris – Trichinella – Wuchereria – Dracanculus. Laboratory techniques in parasitology. Examination of faeces for ova and cysts – Concentration methods. Blood smear examination for parasites. Cultivation of protozoan parasites.

References:

1. Alexopoulus CJ and C W. Mims.(1993).Introductory Mycology (3rd edition) WileyEastern Ltd, New Delhi.
2. Elizabeth Moore-Landecker. (1996). Fundamentals of the fungi.(4th edition). PrenticeHall International, Inc, London
3. Jewetz, E., Melnic, J.L. and Adelberg, E.A. (2000) Review of Medical Microbiology, 19th Edn. Lange Medical Publications, U.S.A.
4. Ananthanarayan, R. and Jeyaram Paniker, C.K. (1994) Text Book of Microbiology, 6th Edn. Orient Longman, Chennai.
5. Jeyaram Paniker, C.K. (2006) Text Book of Parasitology. Jay Pee Brothers, New Delhi.
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CORE VII THEORY: MEDICAL VIROLOGY

UNIT I

General Properties of viruses – Detection of viruses and antigens in clinical specimens – Serological diagnosis of virus infections. Cultivation of Viruses.

UNIT II

Arthropod borne and rodent borne virus diseases – Picorna viruses and diseases. Hepatitis viruses: Rabies and other neuro viruses: Orthomyxo and Paramyxoviruses.

UNIT III

Pox, Adeno, Herpes, Reo, Rota and HIV Viruses, Oncogenic viruses, Viral vaccines, their Preparation and their immunization schedules.

UNIT IV

Viruses of importance to bacteria – Bacteriophages – Their Structure, types – Uses in Microbiology.

UNIT V

Applied virology – Viral diseases, epidemiology diagnosis, prevention and treatment. Vaccines and interferons – Antiviral agents.

References:

1. Jewetz, E., Melnic, J.L. and Adelberg, E.A. (2000) Review of Medical Microbiology, 19th Edn. Lange Medical Publications, U.S.A.
2. Ananthanarayan, R. and Jeyaram Paniker, C.K. (1994) Text Book of Microbiology, 6th Edn. Orient Longman, Chennai
3. Topley & Wilsons's. (1990) Principles of Bacteriology, Virology and Immunity, VIII edition, Vol. III Bacterial Diseases, Edward Arnold, London.
4. Bridge, E.A. (1994) Bacterial and Bacteriophage Genetics, 3rd Edn. Springer–Verlag,New York.
5. Roger Hull (2002). Mathews' Plant Virology. (4thEdition). Academic press-A Harcourt Science and technology company, New York.

CORE V – PRACTICAL: MEDICAL BACTERIOLOGY, MYCOLOGY, PARASITOLOGY AND VIROLOGY

UNIT I

General requirements of collections, transport of clinical Specimens – Methods of enriched, selective and enrichment culture techniques used to isolate organisms from clinical materials. Simple, differential and special staining of clinical materials viz: Throat swab, Pus, Urine, Sputum, Stool etc… Enumeration of Bacteria in Urine, Quantitative Urine Culture.

UNIT II

Isolation and identification of bacterial pathogens from clinical specimens their biological reactions. Antimicrobial Sensitivity testing by disc-diffusion technique and determination of MIC.

UNIT III

Identification of pathogenic viruses in Slides/ Smears / Spotters. Isolation of phage from natural sources.

UNIT IV

KOH and Lactophenol preparations for skin scrapings for dermatophytes. Microscopic identification and cultural characteristics of medically important fungi and lab contaminants.Germ tube, carbohydrate assimilation and fermentation tests for yeasts.

UNIT V

Direct examination of faeces- wet mount and Lugol's iodine method- demonstration of protozoan cysts and helminthes eggs. Concentration techniques of stool specimen- floatation and sedimentation methods. Examination of blood for malarial parasites- thin and thick smear preparation. dentification of pathogenic parasites in slides/ specimens as spotters.

ELECTIVE 1 – THEORY: MICROBIAL GENETICS AND GENETIC ENGINEERING

UNIT I

Molecular concept of gene. Bacterial plasmids – structures & properties; Bacteriophage – Lytic & Lysogenic cycle – phage λ . Structures of bacterial Transposons – Types of bacterial Transposons; Mechanism of Antibiotic resistance.

UNIT II

Gene transfer – transformation, Configuration & transduction; Gene mapping Lac operon – trp operon. Mutations – various types & Mechanism; Ames test, Role of mutation in evolution.

UNIT III

Vectors: Plasmid vectors: pSC101, pBR322, pUC series and Ti plasmids based vectors; Bacteriophage vectors: Lambda phage based vectors, phagemids, cosmids, and M13 based vectors; Viral vectors: Vaccinia, Retroviral, SV40 and Baculoviral system;

UNIT IV

Principles and methods in genetic engineering: Host cell restriction; Restriction modification; Restriction enzymes: Types and applications;; DNA finger printing; RFLP Nucleases, Ribonucleases, DNA ligases, Tag DNA Polymerases, Methylases, Topoisomerases, Gyrases, and Reverse Transcriptases.

UNIT V

Basic steps of cloning techniques; Genomic DNA and cDNA library Construction; Screening methods; Cloning in *E. coli*, Expression systems; Gene fusion and Reporter genes; Gene targeting; Methods of Gene transfer – transformation, transfection, Electroporation, microinjection and biolistics.

References:

1. Brown, T.A. (1995) Gene Cloning. Chapman and Hall, London.

2. Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.
3. Watson JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM. (1998). Molecular biology of the gene, 4th edition, Benjamin/Cummings publishing company
4. Burrell, MM. (1993) Enzymes of Molecular Biology, Humana Press.
5. Old, RW. Primrose, SB. (1994) Principles of Gene Manipulation. Blackwell Scientific Publications.
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8. Glazer AN, Nikaido H. (1994) Microbial Biotechnology - Fundamentals of Applied Microbiology WH Freeman and Company, New York
9. Innis MA. (1995) PCR Strategies, Academic Press.
10. Kreuzer & Massey 2001 - rDNA & Biotechnology. A guide for Teachers, 2nd Edition, ASM press, Washington
11. Lewin B 2003. Genes VII. Oxford University press, New York
12. Lindahl T and West SC ed (1995). DNA repair and recombination, Chapman, Hall and Royal Publishers.
13. Primrose SB (1994) Molecular Biotechnology, 2nd edition, Blackwell Scientific Publications.
14. Gerd Gellissen - 2005. Production of Recombinant Proteins: Novel Microbial and Eukaryotic Expression Systems . Viley VCH Publishers, 426 pages.

ELECTIVE 2 – THEORY: INDUSTRIAL AND PHARMACEUTICAL MICROBIOLOGY

UNIT I

General introduction to fermentation process. Microbial growth kinetics-batch, continuous and fed batch culture. Large scale cultivation of industrially important

microbes (Streptomyces, Saccharomyces, Hansenela, Spirulina and Penicillium) Fermentation media-desired qualities- media formulation strategies- carbon, nitrogen, vitamin, mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams, strain improvements.

UNIT II

Types of fermentation-fermentors-basic functions, design and components, asepsis and containment requirement. Specifications of fermentors- sterilization of fermentors- aseptic inoculation methods. Brief idea on monitoring control device.

UNIT III

Microbial products of commercial use-penicillin, ethanol, vinegar, vitamin B12, protease, citric acid and glutamic acid.

UNIT IV

Downstream processing - objective and criteria, foam separation, precipitation methods, filtration, industrial scale centrifugation and cell disruption methods. Liquid-liquid extraction, solvent recovery- chromatography. Two phase aqueous extraction, super – critical fluid extraction, ultra filtration, drying device, crystallization and whole broth processing.

UNIT V

Ecology of microorganisms affecting pharmaceutical industries- atmosphere-water-raw materials- packaging- equipment. Environmental monitoring in different class level in industries. Factors affecting microbial spoilage of pharmaceutical products - Control of contamination during manufacture- good pharmaceutical manufacturing process. Quality control of pharmaceutical products. Manufacture of sterile pharmaceutical products- injections and ophthalmic preparations. IPR for pharma products.

References:

1. KL Benson (2016) Industrial Microbiology, CBS; 1st edition (2016), ISBN-10: 8123929145

2. E. M. T. El-Mansi and C. F. A. Bryce (2011) Fermentation Microbiology and Biotechnology, Third Edition, CRC Press; 3 edition (December 12, 2011), ISBN-10: 143985579X
3. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1995) Principles of Fermentation Technology, 2nd Edn. Pergamon Press, Oxford.
4. Vedpal's S. Malik, Padma Sridhar, Sharma, M.C. and Polasa, H. (1992). Industrial Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
5. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press.
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7. George Edward Trease and W.C. Evans - Pharmacognosy 12th edition, English Language Books Society, Baelliere Tindall.
8. Handa, S.S. and Kapoor, V.K. Pharamcognosy by 2nd Edition, Vallabh Prakashan Publishers, New Delhi.
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SIXTH SEMESTER

CORE VIII- THEORY: ENVIRONMENTAL MICROBIOLOGY

UNIT I

Introduction: Organization of the biosphere and components of ecosystem, Natural habitats of microoganisms, Microbial communities in aquatic and terrestrial habitats, Microorganisms as components of ecosystem-as producers and decomposers.

UNIT II

Microbial life in extreme environments: Effect of temperature, pH, Pressure, salt and heavy metals such as As, Sb,Hg, Pb and Cd, Microbial life in conditions of high irradiation, Radiosensitivity; mechanism of damage and recovery, Growth in nutrient limited environment – mechanism of adaptations, Microbes in space. Extreme environments.

UNIT III

Microbes in aquatic environments: The nature of aquatic habitats, Methods used in the study of aquatic (fresh and marine water) microbial community, Pollution of aquatic habitats, Water quality criteria, Water-borne diseases, Microbiological analysis of water purity, Indicator organisms, ground water quality and home treatment system.

UNIT IV

Microbes in air: Composition of Air; Number and kinds of organisms in air; Distribution and sources of air borne organisms; Droplet and droplet nuclei; Assessment of air quality; Air sanitation; Airborne diseases;

UNIT V

Environmental application: Waste –types; Treatment of solid wastes –composting, Vermiform composting, silage, Pyrolysis and scarification; Treatment of liquid wastes, degradation of liquid industrial wastes; Degradation of pesticides and detergents; Degradation of lignin; synthetic polymers; Xenobiotic compounds; Alkyl benzyl sulphonates; Petroleum and hydrocarbon degradation. Microorganisms and bioterrosium

References:

1. Ian L. Pepper and Charles P. Gerba (2014) Environmental Microbiology, Third Edition, Academic Press; 3 edition (April 7, 2014), ISBN-10: 0123946263.
2. Dirk, J. Elasas, V., Trevors, J.T., Wellington, E.M.H. (1997). Modern Soil Microbiology, Marcel Dekker INC, New York, Hong Kong.

3. Ec Eldowney S, Hardman D.J., Waite D.J., Waite S. (1993). Pollution: Ecology and Biotreatment – Longman Scientific Technical.
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7. Patricia Cunning (1995). Official Methods of Analysis, Vol. I and II, 16th Edition, Arlington, Virginia, U.S.A., AOAL.
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11. Subba Rao, N.S. (1995) Soil Microorganisms and Plant Growth. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
12. Subbha Rao, N.S. (1995) Biofertilizers in Agriculture and Forestry, 3rd Edn. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
13. Moo-Young, M., Anderson, W.A. and Chakrabarty, A.M. 1996. Environmental biotechnology: Principles and applications. Boston, Mass.: Kluwer Academic Publishers.
14. Benson H.J (1994). Microbiological Applications, WmC Brown Publishers, Oxford

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CORE IX- THEORY: FOOD AND DAIRY MICROBIOLOGY

UNIT I

Food as a substrate for microorganisms–Microorganisms important in food microbiology; Molds, yeasts and bacteria–General Characteristics–Classification and importance.

UNIT II

Principles of food preservation – Asepsis – Removal of micro organisms, anerobic conditions – High temperature – Low temperature- Drying –Food additives.

UNIT III

Contamination and spoilage- Cereals, sugar products, vegetables and fruits, meat and meat products, milk and milk products – Fish and sea foods – poultry, spoilage of canned foods.

UNIT IV

Food borne infections and intoxications – bacterial, non-bacterial – Food borne disease outbreaks – Laboratory testing – preventing measures – Food sanitation – plant sanitation – Employees' heals standards – waste treatment and disposal – quality control.

UNIT V

Food fermentation: Bread cheese, vinegar, fermented vegetables, fermented dairy products. Spoilage and defects of fermented dairy products – oriental fermented foods.

References:

1. Thomas J. Montville and Karl R. Matthews (2012) Food Microbiology: An Introduction, ASM Press; 3 edition (June 10, 2012), ISBN-10: 1555816363
2. Adams MR and Moss MO. (1995). Food Microbiology, The Royal Society of Chemistry, Cambridge.
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6. Robinson RK. (1990) Dairy Microbiology, Elsevier Applied Science, London.
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CORE VI- PRACTICAL: ENVIRONMENTAL, FOOD AND DAIRY MICROBIOLOGY

UNIT I

Detection of number of Bacteria in milk by breed count. Detection of number of bacteria in milk by standard plant count.

UNIT II

Determination of quality of milk sample by methylene blue reductase test and Resorzurin method.

UNIT III

Isolation of yeast and molds from spoiled nuts, fruits, and vegetables. Bacteriological examination of specific food a) Curd b) Raw meat c) Fish d) Ice cream.

UNIT IV

Determination of BOD and COD of wastewater. Water analysis

a) MPN method b) Memberane filter method.

UNIT V

Quantification of microorganisms in air by settle plate and air sampler methods. Detection of aflatoxin B_1 from moldy grains using thin layer chromatography.

ELECTIVE 3 – THEORY: BIOTECHNOLOGY

UNIT I

Biotechnolgy–definition & history; Microbial production of industrial enzymes; methods for immobilization of enzymes; kinetics of soluble and immobilized enzymes; application of soluble and immobilized enzymes; enzyme-based sensors.

UNIT II

Principles and application of genetic recombinant technology and strain improvement (mutational, rDNA technologies). Production of biotechnological products: Food –SCP (algae, yeast, mushroom). Biofertilizer (BGA, VAM) Biopesticides (Bacillus thruingiensis). Fuel –ethanol; Pharmaceuticals – antigens, interferons, vaccines, insulin, gene-therapy methods.

UNIT III

Architecture of plant genome; plant tissue culture techniques; methods of gene transfer into plant cells; production of secondary metabolites using suspension/immobilized cell culture;

UNIT IV

Methods for plant micro propagation; crop improvement and development of transgenic plants.

UNIT V

Animal cell metabolism and regulation; cell cycle; primary cell culture; nutritional requirements for animal cell culture; techniques for the mass culture of animal cell lines; transgenic animals.

References:

1. Balasubramanian, D., Bryce, C., Dharmalingam, K., Green, J. and Jayaraman, K. (1999). Concepts in Biotechnology, University Press, India. M.Sc. Applied Microbiology: Syllabus (CBCS) 58
2. Colin Ratledge and Bjorn Kristiansen (2001). Basic Biotechnology, Cambridge University Press, U.K.
3. Joshi, V.K.and Ashok Pandey. (1999). Biotechnology, Food fermentation (Microbiology, Biochemistry and Technology) Vol. I & II Basic, Educational Publishers and Distributors, Ernakulam.
4. Vedpal's S. Malik, Padma Sridhar, Sharma, M.C. and Polasa, H. (1992). Industrial Biotechnology, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi
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7. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
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13. Old, RW. Primrose, SB. (1994) Principles of Gene Manipulation. Blackwell Scientific Publications.
14. Tuan, RS. (1997) Recombinant Gene expression protocols. Humana Press.
15. Watson, JD., Gilman, M, Witkowski, J. Zoller M. (1992) Recombinant DNA. Scientific American Books.
16. Glazer AN, Nikaido H. (1994) Microbial Biotechnology - Fundamentals of Applied Microbiology WH Freeman and Company, New York
17. Chirikjian JG Eds (1995). Biotechnolgy - Theory and Techniques, Vol. 1, Jones and Burtlett Publishers

CORE – PROJECT AND VIVA VOCE

OBJECTIVE OF THE COURSE

To impart advanced practical knowledge in conducting a research project.

To plan and design statistically, retrieve relevant literature, organize and conduct, process the data, photograph relevant observations, evaluate by statistical programmes. The work has to be conducted in department under the guidance of the project supervisor. Interdisciplinary collaborations from external departments / institutions can be organized only for essential areas of the project. The method of valuation of project report submitted by the candidate is outlined as follows:

Internal (2 out of 3 presentations) - 20 Marks

Project Report and viva - 80 Marks

SYLLABUS FOR ALLIED MICROBIOLOGY SUBJECTS FOR B.SC., BIOCHEMISTRY AND B.SC., BIOTECHNOLOGY

ALLIED MICROBIOLOGY FOR B.SC., BIOCHEMISTRY

Title of the paper	**Allied Microbiology I**		
Category : **Part III** - **Allied Theory**	Year & Semester Second Year/third Semester	Credits 4	Teaching hours 6 hours/week

UNIT I

Evolution of Microbiology. Classification of micro-organisms. Basic microbiological techniques. Cleaning of glassware. Sterilization of glassware and media. Stroak plate, spread plate, pour plate enrichment culture, single spore isolation, serial dilution, standard plate count. Lyophilization. Types of culture media. Staining techniques-simple and differential.

UNIT II

Structural characteristics of Bacteria. Actinomycetes, Mycoplasma and viruses.Structural characteristics of micro algae (Oscillatoria Volvox and Chiorella), fungi (molds and yeasts) and Protozoa Entemoeba Plasmodium and Euglena)

UNIT III

Measurement of microbial growth (turbidity, biomass, cell count, arrea, pigments). Microbiology of Soil. Microbes in soil, rhizophers and rhizoplane. Nitrogen-fixing, nitrifying and denitryfying bacteria. Sulphur bacteria. Biofertilizers.

UNIT IV

Microbiology of water. Potable water. Municipal water purification. Sewage disposal and treatment-Physical and biological.

Title of the paper	**Allied Microbiology I**		
Category : **Part III - Allied Practical**	Year & Semester Second Year/third Semester	Credits 3	Teaching hours 3 hours/week

UNIT I

Cleaning of glass wares Sterilization principle and methods- moist heat- dry heat and filtration methods.

UNIT-II

Media preparation: liquid media, solid media, agar slants, agar plates, basal, enriched, selective media preparation- quality control of media, growth supporting properties, sterility check of media.

UNIT-III

Pure culture techniques: streak plate, pour plate, decimal dilution. Culture characteristics of microorganisms: growth on different media, growth characteristics and description. Demonstration of pigment production.

UNIT-III

Microscopy: light microscopy, bright field microscopy, dark field microscopy. Motility demonstration: hanging drop, wet mount preparation, dark field microscopy, semi solid agar, Craigie's tube method.

UNIT-IV

Staining techniques: smear preparation, simple staining, Gram's staining, acid fast staining, staining of Metachromatic granules

Title of the paper	**Allied Microbiology II**		
Category : **Part III - Allied Theory**	Year & Semester Second Year/fourth Semester	Credits 4	Teaching hours 6 hours/week

UNIT I

Microbiology of air. Microbes in air. Methods of purification of air. Food microbiology. Microbial spoilage of food. Food preservation techniques with special emphasis on preservation of home foods by tunneric, salt, spices, oil and sugar.

UNIT II

Microbiology of milk. Microbes in milk and their sources. Pasteurization. Phosphatase and reduetase tests. Dairy products. Industrial microbiology. Microbes in the production of organicacids, antibiotics and alcoholic beverages.

UNIT III

Microbes and diseases. Pathogenesis. Immune system. Active and passive immunity. AIDS.

UNIT IV

Control of microbes-physical and chemical methods. Personal hygiene and sanitation. A brief account of genetic engineering and biotechnology.

Title of the paper	**Allied Microbiology II**		
Category : **Part III – Practical**	Year & Semester Second Year/fourth Semester	Credits 3	Teaching hours 3 hours/week

UNIT-I

Morphology of microorganisms: morphological variations in algae, morphology of fungi, slide culture technique. Antibiotic sensitivity testing: Disc diffusion test-quality control with standard strains. Micrometry: Demonstration of size of yeast and fungal filaments.

UNIT-II

Physiology characteristics: IMViC test, H_2S, Oxidase, catalase, urease test. Carbohydrate fermentation test, maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

UNIT-III

Observation of pond water for the presence of microorganism-Volvox , Chiorella, Oscillatoria, Entamoeba. Paramoccium and Euglena. Study of photomicrographs of different types of bacteria and viruses.

UNIT-IV

Identification of organisms that spoil the following: Citrus fruits, Grapes, Emblica fruits. Coconut Kernal, Milk Products, bread and jam. Phosphatase and reductase tests. Study of organisms and their substrates in the formation of the following - tactic acid, acetic acid, cathanol, pencillin, streptomysin dairy products and alcoholic beverages.

Reference Books:

1. Ananthanarayan, R. and Paniker, C.K.J. 2000. A text book of Microbiology. 6th edition. Orient Longman Ltd., Hyderabad.
2. Pelzar. 2000. Microbiology. 5th edition. Tata McGraw Hill., New Delhi.
3. Ingraham, J.L., and Ingraham, C.A. 2000. Introduction to microbiology, 2nd edition. Brooks/Cole, Thomson Learning, USA.
4. Carpenter. P.L. 1990. Microbiology. W.B. Saunders.
5. Frazier, W.C. 2000. Food Microbiology. McGraw Hill.
6. Purohit S.S. 1991. Microbiology. Agro Botanical Publishers (India)
7. Salle, A.J. 1998.Fundamental Principles of Bacteriology. Tata McGraw Hill. Bacterial flora of milk and milk products in India. ICAR Publishers.

ALLIED MICROBIOLOGY FOR B.SC., BIOTECHNOLOGY

Title of the paper	**Allied Microbiology**		
Category : **Part III** - **Allied Theory**	Year & Semester first Year/first Semester	Credits 4	Teaching hours 6 hours/week

UNIT- I

History and Scope of Microbiology- Anatomy of Prokaryotes and Eukaryotes- Bacteria, Fungi, Algae, Protozoa and Viruses- structure and functions of the cellular components- Growth and nutrition- media and culture.

UNIT- II

Classification of microbes- DNA analysis, Ribosomal RNA analysis- Numerical taxonomy- Molecular taxonomy- methods of microbial identification.

UNIT- III

Environmental Microbiology- role of microorganisms in the productivity of ecosystems- Role of microorganisms in food production; dairy and non-dairy products- fermented foods and alcoholic beverages- production of food (single cell protein), Fuel (ethanol).

UNIT- IV

Medical Microbiology- Pathogenic microbes- Bacterial, Viral, Fungal and Protozoan diseases. Cure, control and prevention- Pharmaceuticals (antibiotics, vaccines etc.), Biofertilizers (BGA), Biopesticides, biopolymers, biosurfactants.

UNIT- V

Industrial use of microbes- fermentation products- bioconversions- products of industrial microbiology- Streptomyces, yeasts (Saccharomyces, Hansenula), Spirulina and Penicillium.

Title of the paper	**Allied Microbiology**		
Category : **Part III** – **Practical**	Year & Semester first Year/first Semester	Credits 3	Teaching hours 3 hours/week

UNIT I

Cleaning of glass wares Sterilization principle and methods- moist heat- dry heat and filtration methods. Media preparation: liquid media, solid media, agar slants, agar plates, basal, enriched, selective media preparation- quality control of media, growth supporting properties, sterility check of media.

UNIT-II

Pure culture techniques: streak plate, pour plate, decimal dilution. Culture characteristics of microorganisms: growth on different media, growth characteristics and description. Demonstration of pigment production.

UNIT-III

Microscopy: light microscopy, bright field microscopy, dark field microscopy. Motility demonstration: hanging drop, wet mount preparation, dark field microscopy, semi solid agar, Craigie's tube method. Staining techniques: smear preparation, simple staining, Gram's staining, acid fast staining, staining of Metachromatic granules

UNIT-IV

Morphology of microorganisms: morphological variations in algae, morphology of fungi, slide culture technique. Antibiotic sensitivity testing: Disc diffusion test-quality control with standard strains. Micrometry: Demonstration of size of yeast and fungal filaments.

UNIT-V

Physiology characteristics: IMViC test, H2S, Oxidase, catalase, urease test. Carbohydrate fermentation test, maintenance of pure culture, paraffin method, stab culture, maintenance of mold culture.

Reference Books:

1. Pelczar, M.J., Chan, E.C.S., King, N.R., 2001. Microbiology- Concepts and Applications. Tata McGraw – Hill, New Delhi.
2. Ananthanarayan, R. and Paniker, C.K.J. 2000. A text book of Microbiology. 6th edition. Orient Longman Ltd., Hyderabad.
3. Pelzar. 2000. Microbiology. 5th edition. Tata McGraw Hill., New Delhi.
4. Ingraham, J.L., and Ingraham, C.A. 2000. Introduction to microbiology, 2nd edition. Brooks/Cole, Thomson Learning, USA.