KUVEMPU UNIVERSITY, SHIVAMOGGA

CHOICE BASED CREDIT SYSTEM (CBCS)

&

CONTINUOUS ASSESSMENT AND GRADING PATTERN (CAGP)

based

B. Sc. MICROBIOLOGY SYLLABUS

(Case 1: 3 majors with a general degree)

Under

SEP SCHEME: 2024-25 Onwards

Board of Studies in Microbiology
Department of Studies and Research in Microbiology
Kuvempu University
Jnanasahyadri, Shankaraghatta 577 451
Shivamogga, Karnataka, India

Proposed Semester-wise Distribution of the Course Structure
Case 1: 3 Majors with a General Degree for 2024-25
Major -1; Subject-Microbiology

Sem.	Major-1	Major-2	Major-3	Elective/ Optional	Languages	Compulsory
1	5	5	5	-	Language-1/3 Language-2/3	Compulsory-1 (Constitutional values)-2 Environmental Science-3
2	5	5	5	-	Language-1/3 Language-2/3	Compulsory-2 (Constitutional values)-2
3	5	5	5	Elective-1/2	Language-1/3 Language-2/3	
4	5	5	5	Elective-2/2	Language-1/3 Language-2/3	Compulsory-3 (Practical knowledge/ skill-1)-2
5	8	8	8	-	-	Compulsory-4 (Practical knowledge/ skill-2)-2
6	8	8	8	-	-	Compulsory-5 (Practical knowledge/ skill-3)-2
Total	**36**	**36**	**36**	**04**	**24**	**13**
Grand Total Credits - 149						

Curriculum Structure for Undergraduate Programme for 2024-25
Syllabus to be framed by respective Science subjects (Departments) for Microbiology

Sl. No.	Course/Paper Code	Title of the Paper	Subject Category	Teaching Hours/ week	Semester End Exam.	Internal Assessment	Total Marks	Credits	Examination Duration
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Semester-I									
1	24-MC-I		MC-T	04	80	20	100	03	3 Hrs.
	Practical – I		MC-P	04	40	10	50	02	3 Hrs.
	Total			**08**	**120**	**30**	**150**	**05**	---
Semester-II									
2	24-MC-II		MC-T	04	80	20	100	03	3 Hrs.
	Practical – II		MC-P	04	40	10	50	02	3 Hrs.
	Total			**08**	**120**	**30**	**150**	**05**	---
Semester-III									
3	24-MC-III		MC-T	04	80	20	100	03	3 Hrs.
	Practical – III		MC-P	04	40	10	50	02	3 Hrs.
	Elective/Optional – I*		EL-I	02	40	10	50	02	2 Hrs.
	Total			**10**	**160**	**40**	**200**	**07**	---
Semester-IV									
4	24-MC-IV		MC-T	04	80	20	100	03	3 Hrs.
	Practical – IV		MC-P	04	40	10	50	02	3 Hrs.
	Elective/Optional-II*		EL-II	02	40	10	50	02	2 Hrs.
	Practical knowledge/ skill-I		SK-I	02	40	10	50	02	2 Hrs.
	Total			**12**	**200**	**50**	**250**	**09**	---
Semester-V									
5	24-MC-V		MC-T	04	80	20	100	03	3 Hrs.
	24-MC-VI		MC-T	04	80	20	100	03	3 Hrs.
	Practical – V		MC-P	04	40	10	50	02	3 Hrs.
	Practical knowledge/ skill-II		SK-II	02	40	10	50	02	2 Hrs.
	Total			**14**	**240**	**60**	**300**	**10**	---
Semester-VI									
6	24-MC-VII		MC-T	04	80	20	100	03	3 Hrs.
	24-MC-VIII		MC-T	04	80	20	100	03	3 Hrs.
	Practical – VI		MC-P	04	40	10	50	02	3 Hrs.
	Practical knowledge/ skill-III		SK-III	02	40	10	50	02	2 Hrs.
	Total			**14**	**240**	**60**	**300**	**10**	---
	Grand total			**66**	**1080**	**270**	**1350**	**46**	---

MC: *Major Course*; MC-T: *Major Course Theory*; MC-P: *Major Course Practical*; El/Op: *Elective/Optional*; AEDP: *Apprenticeship Embedded Degree Programme*. *In Semester-III and Semester-IV elective papers are offered. In Semester-III, the Compulsory paper is Environmental Studies. There shall be two elective papers offered in Semester-III and Semester-IV by every major subject offering departments. Out of this, a student shall choose/select/opt ONE elective paper in each semester. (i.e Semester-III and Semester-IV) respectively. In Semester-VI, V and VI there shall be one Practical knowledge/ skill paper offered by each major subject of which a student shall opt ONE in each semester.

Curriculum Structure for Undergraduate Programme for 2024-25

Case 1: 3 Majors with a general degree in all 6 semesters – Number of courses and credits course-wise in all semesters

Semester	Major Course (Paper) Major 1	Elective/ Optional	AEDP
01 Theory paper and 01 Practical paper in each Major Subject (T+P)			
I	3+2 = 5		
II	3+2 = 5	---	
III	3+2 = 5	Elective 1- 2	
IV	3+2 = 5	Elective 2- 2	Practical knowledge/ skill-I-2
V	3+3+2 = 8	---	Practical knowledge/ skill-II-2
VI	3+3+2 = 8	---	Practical knowledge/ skill-II-2
Total	36	04	06
Grand Total 46 Credits			

Note:

1. Credit for the three major courses includes theory, practical (skill enhancement course), and tutorial/assignment/survey-based assignment/internship.
2. Practical paper(s) (Compulsory/Skill enhancement course) should provide practical experience which is complimentary to theory major paper(s).
3. Project Work/Dissertation/Internship/Apprenticeship Embedded Degree Programme (AEDP) should also be considered to be part of the curriculum.

Undergraduate Microbiology Syllabus
(Case 1: 3 Majors with a General Degree) for 2024-25
Proposed semester-wise distribution of the course structure

Paper code	Paper type	Title of the paper	Credits Assigned	Instructional hours per week
SEMESTER – I				
DSC	Theory-I	Introduction to Microbiology and Microbial Diversity	**3**	**4**
DSC	Practical-I	Introduction to Microbiology and Microbial Diversity	**2**	**4**
SEMESTER – II				
DSC	Theory-II	Microbial Physiology and Genetics	**3**	**4**
DSC	Practical-II	Microbial Physiology and Genetics	**2**	**4**
SEMESTER – III				
DSC	Theory-III	Molecular Biology and Environmental Microbiology	**3**	**4**
DSC	Practical-III	Molecular Biology and Environmental Microbiology	**2**	**4**
ELE	Elective:Theory-1	Microbial Quality Control in Industries	**2**	**2**
SEMESTER – IV				
DSC	Theory-IV	Genetic Engineering and Agricultural Microbiology	**3**	**4**
DSC	Practical-IV	Genetic Engineering and Agricultural Microbiology	**2**	**4**
ELE	Elective:Theory-2	Plant and Animal Microbiome	**2**	**2**
SEC	Skill-Theory-1	Microbial and Molecular Techniques	**2**	**2**
SEMESTER – V				
DSC	Theory-V	Food Microbiology	**3**	**4**
DSC	Theory-VI	Industrial Microbiology	**3**	**4**
DSC	Practical-V	Food Microbiology and Industrial Microbiology	**2**	**4**
SEC	Skill-Theory-2	Bioinformatics and Intellectual Property Rights	**2**	**2**
SEMESTER – VI				
DSC	Theory-VII	Immunology	**3**	**4**
DSC	Theory-VIII	Medical Microbiology	**3**	**4**
DSC	Practical-VI	Immunology and Medical Microbiology	**2**	**4**
SEC	Skill-Theory-3	Microbial Diagnosis in Health Clinics	**2**	**2**
		Total	**46**	**66**

DSC - Discipline Specific Course, ELE - Elective, SEC- Skill Enhancement Course

SCHEME OF VALUATION

MAXIMUM MARKS

COURSE TYPE	C1		C2		C3		TOTAL
	THEORY	LAB	THEORY	LAB	THEORY	LAB	
DSC	5+5	5	5+5	5	80	40	150
ELE	5		5		40		50
SEC	5		5		40		50

NOTE;

1. C1 and C2 will be conducted for 20 marks (theory) with 60 minutes duration, 10 marks (lab) with continuous assessment through record valuation and marks reduced to assigned marks.
2. C3 will be conducted for 80 marks (theory) with 3 hours duration, 40 marks (lab) with 3 hours duration.
3. In case of ELE and SEC, C1 and C2 will be conducted for 10 marks with 30 minutes duration and reduce to assigned marks. C3 will be conducted for 40 marks with 2 hours duration.

Practical Proper Examination I-VI semesters Duration: 3Hrs

- Experimentation (Major & Minor/Spotters) - 35 Marks
- Viva Voce - 05 Marks

Total - 40 Marks

Internal Assessment for Practical Paper I-VI semesters

- Attendance/ Internal Assessment test - 05 Marks
- Record - 05 Marks

Total - 10 Marks

Continuous Assessment Programme/Internal Assessment/ Formative Assessment
Major Courses

Sl. No.	Continuous Assessment Programme/Internal Assessment	Maximum Marks
(1)	(2)	(3)
01	Two session tests with a proper record for assessment (5+5)	10
02	Assessment of skill development activities/seminars/group discussion /assignment etc., with proper record	05
03	*Attendance with proper record*	05
TOTAL MARKS		20

Attendance Marks-breakup

Percentage of Attendance	Marks
<75	00
75-80	01
80-85	02
85-90	03
90-95	04
>95	05

Continuous Assessment Programme/Internal Assessment/ Formative Assessment
Elective/Optional Papers/Practical knowledge/ skill paper

Sl. No.	Continuous Assessment Programme/Internal Assessment	Maximum Marks
(1)	(2)	(3)
01	Assessment of skill development activities/seminars/group discussion /assignment/attendance etc., with proper record	05
02	Session tests with a proper record for assessment	05
TOTAL MARKS		10

Attendance Marks-breakup

Percentage of Attendance	Marks
<75	00
75-85	01
85-95	02
>95	03

FIFTH SEMESTER

Course Learning Objectives:

a. To understand the basis of microbial spoilage of various foods and food borne diseases.
b. To give knowledge about the principle of food preservation and food control.
c. To discuss the microbial quality of milk and nutritional value of milk products.
d. To study the production of fermented foods and their therapeutic value.
e. To create awareness on the food hygiene and food safety.

Course Outcomes: After the successful completion of the course, the student will be able to:

a. Understand the sources of contamination of food and impact of food borne illnesses.
b. Develop knowledge about the various methods of food preservation and food laws.
c. Get expertise in the microbiological analysis of milk and milk products.
d. Demonstrate the large scale production of various fermented foods.

DSC-5: FOOD MICROBIOLOGY

PAPER-V **48 (4hrs./week)**

Unit I **Introduction to Food Microbiology and Food Spoilage** **12 hrs.**

Definition, concepts and scope of Food Microbiology. Food as a substrate for growth of microorganisms. Intrinsic and extrinsic factors affecting growth and survival of microbes in foods. Food spoilage**:** Sources of food contamination, principles of food spoilage, microbial spoilage of meat, poultry and fish. Microbial spoilage of cereals, fruits and vegetables. Microbial spoilage of canned foods. Food borne infection and intoxication**:** Salmonellosis*,* staphylococcal food poisoning*,* botulism and aflatoxicosis*.*

Unit II **Food preservation and Food Control** **12 hrs.**

Principles of food preservation. Methods of food preservation: physical methods- High temperature (canning, blanching and retort processing), low temperature (chilling and freezing), drying (solar drying, drum drying and spray drying), radiation (Gamma and UV irradiation). Chemical methods: salient features and classes of the chemical preservatives. Mode of action and uses of chemical preservatives: salt, sugar, organic acids (propionates, benzoates and sorbates), SO_2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins. Food control: Good Hygiene Practices (GHP) in food industries, food laws in India and food labels.

Unit III **Dairy Microbiology** **12 hrs.**

Composition of milk. Sources of contamination of milk. Biochemical changes of milk- souring, gassy fermentation, proteolysis, lipolysis and ropiness. Microbiological analysis of milk: Rapid platform tests (organoleptic evaluation, clot on boiling, alcohol test, phosphatase test, direct

microscopic count), standard plate count and dye reduction tests (MBRT and RRT). Preservation of milk and milk products- pasteurization, dehydration and sterilization.

Unit IV **Fermented foods** **12 hrs.**

Fermented foods: Definition and characteristics. Starter culture- Salient features, types and role. Fermented dairy products: nutritional value, production and therapeutic values of cheese, tofu, yoghurt and acidophilus milk. Fermented non-dairy products: cereal (idli), vegetable (sauerkraut), meat (sausage) and fish (fish sauce). Fermented beverages-kombucha. Microbes as food. Prebiotics, probiotics, synbiotics and nutraceuticals.

Text Books / References

1. Adams, M. R. and Moss, M. O. (2016). Food Microbiology (4th ed). Royal Society of Chemistry , Cambridge University Press.
2. Ananthanarayanan, R., and Paniker, C. K. J. (2021). Textbook of Microbiology (12th ed.). Orient Longman.
3. Banwart, G. J. (1987.) Basic Food Microbiology. CBS Publishers and distributors, New Delhi.
4. Banwart, G. J. (2012). Basic Food Microbiology (3rd ed.). CBS Publishers and Distributors.
5. Frazier & Westhoff, D. C. (1995). Food Microbiology Tata McGraw Hill Pub. Company Ltd.,New Dehli.
6. Frazier, W. C., & Westhoff, D. C. (2018). Food Microbiology (5th ed.). Tata McGraw Hill.
7. Hammer, B. W., & Babal, R. (2019). Dairy Microbiology (4th ed.). Prentice Hall.
8. Hobbs, B. C. (2015). Food Microbiology (6th ed.). Arnold-Heinemann.
9. Jay, J. M. (2019). Modern Food Microbiology (8th ed.). Springer.
10. Robinson, R. K. (2018). Dairy Microbiology (3rd ed.). Elsevier.
11. Varnam, A. H., & Evans, M. G. (2017). Foodborne Pathogens (3rd ed.). Springer.

FIFTH SEMESTER

Course Learning Objectives:

a. To study microorganisms of industrial importance and design of various fermentors.
b. To understand the composition of fermentation media and fermentation process.
c. To discuss the role of upstream and downstream processing in product recovery.
d. To demonstrate the microbial production of industrial products and their uses.
e. To realize the role of microbiologist in QC and job opportunities in industries.

Course Outcomes: After the successful completion of the course, the student will be able to:

a. Explore various microorganisms in the commercial production of industrial products.
b. Get expertise in formulating the fermentation media for industrial production.
c. Employ an ideal method of downstream processing for recovery of fermented products.
d. Acquire the knowledge in the production and uses of diverse fermented products.

DSC-6: INDUSTRIAL MICROBIOLOGY

PAPER-VI **48 (4hrs./week)**

Unit I **Introduction to Industrial Microbiology** **12 hrs.**

Scope and concepts of Industrial Microbiology. Microorganisms of industrial importance. Criteria for selection of industrially important microorganisms. Primary and secondary screening. Strain improvement and preservation. Fermentor: Design and components of a bioreactor. Specialized bioreactors: Airlift bioreactors, fluidized bed reactor, packed bed reactors, photo-bioreactors and membrane bioreactors. Sterilization of fermentor. Control of air, temperature and pH during fermentation process. Aseptic inoculation and sampling methods.

Unit II **Fermentation media and process** **12 hrs.**

Fermentation media-strategies for media formulation, natural and synthetic media. Production medium and inoculum medium. Raw materials (molasses and its types, corn steep liquor, sulphite waste liquor and whey). Buffers, precursors, inducers, inhibitors and antifoam agents. Types of fermentation process: Submerged fermentation, solid state fermentation (koji), batch fermentation and continuous fermentation.

Unit III **Downstream processing** **12 hrs.**

Downstream processing: Definition and stages. Methods of downstream processing: Precipitation, filtration, centrifugation, distillation, cell disruption, solvent recovery, drying and crystallization. Enzyme immobilization: Definition and methods- reversible immobilization (adsorption), irreversible immobilization (covalent coupling, entrapment, copolymerization). Support materials: Characteristics and types (organic and inorganic). Applications of enzyme immobilization. Immobilized enzymes: Advantages and disadvantages.

Unit IV **Microbial production of industrial products** **12 hrs.**

Industrial production and uses of alcohol (ethyl alcohol, bioethanol and wine), antibiotics (penicillin), organic acids (vinegar, citric acid), enzymes (amylase) and single cell proteins (*Spirulina*). Oyster mushroom cultivation and its nutritional value. Role of microorganisms in the recovery of minerals and petroleum. Role of microbes in biofuel production. Single cell oils

Text Books / References

1. Arindam Kuila and Vinay Sharma (2018). Principles and Applications of Fermentation Technology,Wiley.
2. Casida L E. (2016). Industrial Microbiology, 2nd edition, New Age International Publisher.
3. Casida, L. E. (2018). Industrial Microbiology (3rd ed.). New Age International Publishers.
4. Michael, J.W., Neil L. Morgan (2013). Industrial Microbiology: an Introduction. Blackwell science
5. Nduka Okafor, Benedict Okeke (2017). Modern Industrial Microbiology and Biotechnology. 2ndEdition :CRC Press Publishers
6. Reed, G. (2017). Industrial Microbiology (4th ed.). MacMillan Publications.
7. Sherwood L. M. and Woolverton C. J. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill HigherEducation.
8. Stanbury P. F., W. Whitaker and S.J. Hall (2016). Principles of Fermentation Technology. 3rd edition. Elsevier publication
9. Stanbury, P. T. and Whitaker, (1984) Principles of Fermentation Technology, Pergamong Press, Newyork.
10. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L., and Painter, P. R. (2019). General Microbiology (6th ed.). Prentice Hall of India.

V SEMESTER

FOOD MICROBIOLOGYAND INDUSTRIAL MICROBIOLOGY

PRACTICAL-V **(4hrs/week)**

1. Isolation and enumeration of bacteria from spoiled vegetables/fruits.
2. Isolation and identification of fungi from spoiled vegeables/fruits.
3. Quantitative examination of bacteria in raw and pasteurized milk by SPC method.
4. Turbidity test to detect efficiency of sterilization.
5. Methylene blue reduction test and Resazurin test to determine the quality of milk.
6. Determination of efficiency of Pasteurization by Phosphatase test.
7. Casien hydrolysis test / Direct Microscopic Count / Clot on boiling test.
8. Litmus milk test / Titrable acidity of milk / Alcohol test for milk.
9. Isolation and biochemical characterization of lactic acid bacteria from fermented dairy products.
10. Preparaion of wine from grapes.
11. Preparation of alcohol using jaggery/molasses.
12. Estimation of citric acid produced from *Aspergillus niger* by titrimetric method.
13. Estimation of % alcohol in a given sample by specific gravity bottle method.
14. Culturing of *Spirulina/Chlorella.*
15. Visit to food industries/ food research laboratories, dairy industries and distilleries.

FIFTH SEMESTER

SEC-2: BIOINFORMATICS AND INTELLECTUAL PROPERTY RIGHTS

SKILL PAPER-2 **32 (2hrs./week)**

Unit I **Bioinformatics** **16 hrs.**

Introduction to bioinformatics. Basic concepts of genomics, transcriptomics, proteomics. Biological databases: Types and importance. Mode of data storage: FASTA, Genbank and Uniprot. Data submission and retrieval from NCBI, EMBL, DDBJ, Uniprot and PDB. BLAST: Types and algorithm. Substitution matrices: PAM and BLOSUM matrices. Multiple sequence alignment: Methods and tools- ClustalW and T-Coffee. Significance of alignments: E value and scores diversity of genomes (viral, prokaryotic and eukaryotic genomes). Phylogenetic analysis: Types of phylogenetic trees, different approaches of phylogenetic tree construction- UPGMA, Neighbour joining, maximum parsomony, maximum likelihood. Concept of genome annotation. Methods and tools of gene identification: GenScan, Grail, GeneID and Glimmer.

Unit II **Intellectual Property Rights** **16 hrs.**

Introduction to intellectual property: Patents and their types, trademarks, copyright and related rights, industrial design and rights, traditional knowledge, geographical indications, importance of IPR, patentable and non patentable inventions, patenting life-legal protection of biotechnological inventions. World Intellectual Property Rights Organization (WIPO). Grant of patent and patenting authorities. Types of patent applications: ordinary, conventional, divisional and patent of addition. An introduction to patent filing procedures. Patent licensing and agreement. Patent infringement: Meaning, scope, litigation, case studies. Rights and duties of patent owner.

Text Books / References

1. Attwood T. K. and Parry-Smith D. J. Introduction to Bioinformatics. Pearson Edu.
2. Bare Act, (2007). Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
3. Baxevanis A. D., Ouellette B. F. F. Bioinformatics: A practical guide to the analysis of genes and proteins (John Wiley and Sons).
4. Goel, D. and Prashar, S. (2013). IPR, Biosafety and Bioethics. Pearson.
5. Lesk M. A. Introduction to Bioinformatics. Oxford Publication, 3rd International Student Edition
6. Mittal, D. P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
7. Rastogi S.C., Mendiratta N. and Rastogi P. Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
8. Singh, K. K. (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.

SIXTH SEMESTER

Course Learning Objectives:

a. To impart knowledge on organs, tissues and cells of immune system.
b. To understand the properties, structure and function of immunoglobulins.
c. To study the antigen-antibody reactions and their significance in disease diagnosis.
d. To discuss the hypersensitivity reactions and autoimmune diseases.
e. To demonstrate various immunotechniques and create awareness on immunoprophylaxis.

Course Outcomes: After the successful completion of the course, the student will be able to:

a. Understand the role of immune system in combating infectious diseases.
b. Practice the serological methods to detect antigen and antibody in the samples.
c. Get hands on experience in disease diagnosis using immunotechniques.
d. Gain knowledge about types, mechanism and impact of hypersensitivity reactions.

DSC-7: IMMUNOLOGY

PAPER-VII **48 (4hrs./week)**

Unit I **Introduction to Immune System** **12 hrs.**

Historical perspective of immunology. Immunity: definition and types- innate and adoptive immunity. Primary and secondary immune response. Cells of immune system: B and T lymphocytes, natural killer (NK) cells, granulocytes (neutrophils, eosinophils and basophils), monocytes and macrophages, dendritic cells and mast cells. Organs of immune system: Primary lymphoid organs- bone marrow and thymus and secondary lymphoid organs-spleen and lymph nodes. Lymphoid tissues- MALT and GALT. Lymphatic network.

Unit II **Antigen and Antibody** **12 hrs.**

Antigen- definition, properties and types. Immunogenicity, antigenicity, epitopes, haptens. Properties of a good antigen: Degree of foreignness, molecular weight and degradability. Adjuvants and their importance. Antibody: Definition and basic structure of Ig G. Classes, properties and functions of human immunoglobulins (IgG, IgA, IgM, IgD and IgE). Antigenic determinants on immunoglobulins: Isotype, allotype and idiotype. VDJ rearrangements. Monoclonal and polyclonal antibodies.

Unit III **Antigen-antibody reactions** **12 hrs.**

Definition, salient features and stages of antigen-antibody reactions. Antibody affinity, antibody avidity and cross reaction. Human blood types and Rh factors. Agglutination reactions: Widal test and hemagglutination. Immunoprecipitation: Radial (Mancini method) and double (Ouchterlony method) immunodiffusion. Immunoelectrophoresis. Flocculation: VDRL test. Complement

mediated opsonization and complement fixation test. Immunotechniques: ELISA, radioimmunoassay and immunofluorescence. Serotyping.

Unit IV **Hypersensitive reactions** **12 hrs.**

Hypersensitivity reaction: Definition, classification and mechanism. Antibody mediated hypersensitivity: Type-I (IgE), type-II (IgG and IgM-ADCC), type-III (Antigen-antibody complex) and Cell mediated hypersensitivity type-IV (DTH). Major histocompatibility complex: Structure and functions of MHC I and II molecules. Autoimmne diseases. Immunoprophylaxis: Vaccines- Definition and types- killed, live attenuated and toxoid with an example for each. National immunization schedule and Mission Indradhanush.

Text Books / References

1. Abbas, A. K., Lichtman, A. H., and Pillai, S. (2022). *Cellular and Molecular Immunology* (10th ed.). Elsevier.
2. Ananthanarayan, R. and Paniker, C. K. J. (2021). *Textbook of Microbiology* (12th ed.). Orient Longman.
3. Delves P., Martin S., Burton D. and Roitt I. M. (2006). Roitt's Essential Immunology.11th edition Wiley-Blackwell Scientific Publication, Oxford.
4. Goldsby, R. A., Kindt, T. J., Osborne, B. A., and Kuby, J. (2021). *Kuby Immunology* (8th ed.). W.H. Freeman.
5. Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark D. P. (2014). Brock Biology of Microorganisms.14th edition. Pearson International Edition
6. Murphy, K, Travers, P. and Walport, M. (2008). Janeway's Immunobiology.7th edition Garland Science, Publishers, New York.
7. Peakman, M. and Vergani D. (2009). Basic and Clinical Immunology, 2nd edition Churchill, Livingstone Publishers, Edinberg.
8. Pelczar, M. J., Chan, E. C. S., and Krieg, N. R. (2020). *Microbiology* (7th ed.). McGraw Hill.
9. Richard, C. and Geiffrey, S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.
10. Roitt, I. M. (2017). *Essentials of Immunology* (12th ed.). Blackwell Scientific Publishers.
11. Willey, J. M., Sherwood, L. M., and Woolverton, C. J. (2013). Prescott, Harley and Klein's Microbiology.9th edition. McGraw Hill Higher Education

SIXTH SEMESTER

Course Learning Objectives:

a. To discuss the normal flora of human body and their significance.
b. To study various diseases caused by bacteria and their prevalence.
c. To understand emerging and reemerging viral infections and diseases of parasites and fungi.
d. To gain knowledge about properties and mode of action of antimicrobial agents.
e. To learn and practice disease diagnosis and antibiotic sensitivity among infectious agents.

Course Outcomes: After the successful completion of the course, the student will be able to:

a. Differentiate normal microbiota of human body from pathogenic microbes.
b. Acquire knowledge about symptoms, transmission and control of various infectious diseases.
c. Determine the minimal inhibitory concentration of an antibiotic in disease treatment.
d. Get practical exposure on immunological and molecular methods used in disease diagnosis.

DSC-7: MEDICAL MICROBIOLOGY

PAPER-VIII **48 (4hrs./week)**

Unit I **Introduction to Medical Microbiology** **12 hrs.**

History and development of medical microbiology. Normal microflora of human skin, oral cavity, gastrointestinal tract, urogenital tract and their importance. Host pathogen interaction: Definitions-infection, invasion, pathogenicity, virulence, attenuation, exaltation and toxigenicity. Predisposing factors for pathogenicity. Carriers and their types. Infection: Types of infection, modes of transmission, portal of entry of pathogen. Sample collection, transport and diagnosis.

Unit II **Medical Bacteriology** **12 hrs.**

Etiology, pathogenesis, symptoms, epidemiology, laboratory diagnosis, prophylaxis and treatment of the following- respiratory diseases caused by *Streptococcus pyogenes*, *Haemophilus influenzae* and *Mycobacterium tuberculosis.* Gastrointestinal diseases caused by: *Escherichia coli*, *Salmonella typhi* and *Helicobacter pylori*. Other diseases caused by *Treponema pallidum, Neisseria gonorrhoeae, Bacillus anthracis, Clostridium tetani* and *Clostridium difficile.*

Unit III **Medical Virology Parasitology and Mycology** **12 hrs.**

Medical Virology: etiology, symptoms, mode of transmission, prophylaxis and treatment of serum hepatitis, rabies, dengue, AIDS, covid-19, Kyasanur Forest Disease (KFD) and chikungunya. Disease caused by parasites: Malaria and Kala-azar. Fungal infections: Cutaneous mycoses (Tinea infections), systemic mycoses (Histoplasmosis) and opportunistic mycoses (Candidiasis).

Unit IV **Antimicrobial agents** **12 hrs.**

Chemotherapy: Definition and history. General characteristics and classification of antimicrobial agents. Antimicrobial spectrum of activity for antimicrobial agents. Mode of action of antibacterial agents: Inhibition of nucleic acid synthesis, cell wall synthesis, cell membrane function, protein synthesis and metabolism. Mechanism of action of antibacterial agents (amoxycillin and streptomycin), antifungal agents (amphotericin B and griseofulvin), antiviral agents (acyclovir and azidothymidine). Drug toxicity. Antibiotic resistance: MDR, XDR, MRSA, NDM-1. Management of antibiotic resistance.

Text Books / References

1. Ananthanarayan R. and Paniker C. K. J (2009). Textbook of Microbiology, 8th Edition, University Press,Publication.
2. Bhatra, R. (2021). *Essentials of Medical Microbiology* (2nd ed.). Jaypee Brothers Medical Publishers.
3. Brooks G. F., Carroll K. C., Butel J. S., Morse S. A. and Mietzner, T. A. (2013). Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
4. Douglas, J. W., & Sleigh, J. D. (2019). *Medical Bacteriology* (4th ed.). Churchill Livingstone.
5. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier
6. Goldsby, R. A., Kindt, T. J., Osborne, B. A., & Kuby, J. (2021). *Kuby Immunology* (8th ed.). W.H. Freeman.
7. Gupte, S. (2019). *The Short Textbook of Medical Microbiology* (10th ed.). Jaypee Brothers Medical Publishers.
8. Hughes, W. T., and Moffet, H. L. (2018). *Clinical Microbiology* (5th ed.). J.B. Lippincott.
9. Jawetz, E., Melnick, J. L., and Adelberg, E. A. (2020). *Medical Microbiology* (28th ed.). McGraw Hill.
10. Kenneth, J. R. (2019). *Medical Microbiology: Introduction to Infectious Diseases* (6th ed.). Prentice Hall International.
11. Madigan M. T., Martinko J. M., Dunlap P. V. and Clark D. P. (2014). Brock Biology of Microorganisms.14thedition. Pearson International Edition
12. Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. (2020). *Microbiology* (7th ed.). McGraw Hill.
13. Willey J. M, Sherwood L. M, and Woolverton CJ. (2013). Prescott, Harley and Klein's Microbiology.9th edition. McGraw Hill Higher Education

SEMESTER-VI

IMMUNOLOGY AND MEDICAL MICROBIOLOGY

PRACTICAL-VI **(4hrs/week)**

1. Determination of blood group and Rh factor.
2. Demonstration of prcipitation reaction- Ouchterlony double diffusion.
3. Demonsatration of single radial immunodiffusion.
4. Widal test/ HCG test.
5. RPR test/VDRL test.
6. Differential count of WBC.
7. Culturing of microorganisms- Urine culture.
8. Identify bacteria (*Escherichia coli, Bacillu*s sp.) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests.
9. Study of bacterial flora of skin by swab method.
10. Cultural, morphological and biochemical characteristics of *Staphylococcus/ Streptococcus.*
11. Study of composition and use of important differential media for identification of bacteria: EMB agar, mannitol salt agar, deoxycholate citrate agar, blood agar, TCBS agar and sabouraud dextrose agar
12. Perform antibacterial sensitivity by Kirby-Bauer method.
13. Study of various stages of malarial parasite in RBCs using permanent mounts.
14. Material/Microscopic observation/display of photographs of human pathogens as per theory syllabus- *Mycobacterium tuberculosis, Treponema pallidum, Salmonella typhi,* Hepatitis B virus*,* HIV*, Candida albicans, Tinea, Plasmodium.*
15. Visit to pharmaceutical industry and pathology laboratory.

SIXTH SEMESTER

SEC-3: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

SKILL PAPER-3 **32 (2hrs./week)**

Unit I **Importance of Diagnosis of Diseases** **16 hrs.**

Bacterial, viral, fungal and protozoan diseases of various human body systems, Disease associated clinical samples for diagnosis. Collection of clinical samples: Oral cavity, throat, skin, blood, CSF, urine and faeces and precautions required. Method of transport of clinical samples to laboratory and storage. Direct microscopic examination of culture. Examination of sample by staining: Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria. Preparation and use of culture media - chocolate agar, BHI agar, Lowenstein-Jensen medium, MacConkey agar. Distinct colony characteristics of various bacterial pathogens.

Unit II **Serological and Molecular Methods of Diagnosis** **16 hrs.**

Serological methods: agglutination reactions, Enzyme Linked Immunosorbant Assay (ELISA), immunofluorescence, nucleic acid based methods- polymerase chain reaction, Nucleic acid probes. Kits for rapid diagnosis of diseases: Typhoid, Dengue, HIV and Swine flu. Testing for antibiotic sensitivity in bacteria: importance, determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of Minimal Inhibitory Concentration (MIC) of an antibiotic by serial double dilution method.

Text Books / References

1. Ananthanarayan, R. and Paniker, C. K. J. (2009). Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks, G. F., Carroll, K. C., Butel, J. S., Morse, S. A. and Mietzner, T. A. (2013). Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Collee, J. G., Fraser, A. G., Marmion, B. P., Simmons, A. (2007). Mackie and Mccartney Practical Medical Microbiology, 14th edition, Elsevier.
4. Hughes, W. T., and Moffet, H. L. (2018). *Clinical Microbiology* (5th ed.). J.B. Lippincott.
5. Kenneth, J. R. (2019). *Medical Microbiology: Introduction to Infectious Diseases* (6th ed.). Prentice Hall International.
6. Peakman. M. and Vergani D. (2009). Basic and Clinical Immunology,2nd edition Churchill, Livingstone Publishers, Edinberg.
7. Randhawa, V. S., Mehta G. and Sharma K. B. (2009). Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd
8. Tille, P. (2013). Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby.

SCHEME OF PRACTICAL EXAMINATION

V SEMESTER

PRACTICAL-V: FOOD MICROBIOLOGY AND INDUSTRIAL MICROBIOLOGY

Duration: 3 hours **Max. Marks: 40**

I. Demonstrate or perform the experiment A giving principle and procedure. Record the result. 10 Marks

(Isolation of microflora from spoiled vegetables or fruits / SPC of milk / Turbidity test / Titrable acidity of milk / Methylene blue reduction test and Resazurin test)

(Demonstration- 5 Marks, Principle and Procedure- 4 Marks and Result- 1 Mark)

II. Perform or demonstrate the experiment B giving principle and procedure. Record the result. 10 Marks

(Estimation of citric acid produced from *Aspergillus niger* by titrimetric method / Estimation of % alcohol in a given sample by specific gravity bottle method)

(Demonstration- 5 Marks, Principle and Procedure- 4 Marks and Result- 1 Mark)

III. Conduct or identify the test C. Record and interpret the result. 06 Marks

(Casien hydrolysis test / Litmus milk test / Direct microscopic count / Clot on boiling test / Alcohol test for milk / Phosphatase test / Culturing of *Spirulina/Chlorella*)

(Conduct / Identification- 3 Marks, Result- 1 Mark, Interpretation- 2 Marks)

IV. Write critical notes on D, E and F. 3x3=09 Marks

(Cheese, yoghurt, sausage, kombucha, fish sauce, casien hydrolysis test, litmus milk test, resazurin test, Phosphatase test, molasses, bioreactor, wine, mushroom, *Spirulina*, salt, sugar, vinegar)

(Identification- 1 Mark and Critical comments- 2 mark)

V. Viva-voce 05 Marks

QUESTION PAPER PATTERN OF PRACTICAL EXAMINATION

V SEMESTER

PRACTICAL-V: FOOD MICROBIOLOGY AND INDUSTRIAL MICROBIOLOGY

Duration: 3 hours **Max. Marks: 40**

I. Demonstrate or perform the experiment A giving principle and procedure. Record the result. 10 Marks

II. Perform or demonstrate the experiment B giving principle and procedure. Record the result. 10 Marks

III. Conduct or identify the test C. Record and interpret the result. 06 Marks

IV. Write critical notes on D, E and F. 3x3=09 Marks

V. Viva-voce 05 Marks

SCHEME OF PRACTICAL EXAMINATION

VI SEMESTER

PRACTICAL-VI: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

Duration: 3 hours **Max. Marks: 40**

I. Demonstrate or perform the experiment A giving principle and procedure. Record the result. 10 Marks

(Determination of blood group and Rh factor / Ouchterlony double diffusion test / Widal test / VDRL test)

(Demonstration- 5 Marks, Principle and Procedure- 4 Marks and Result- 1 Mark)

II. Perform or demonstrate the experiment B giving principle and procedure. Record the result. 10 Marks

(Isolation of bacteria from urine sample / Study of bacterial flora of skin by swab method / Antibiotic sensitivity by Kirby-Bauer method)

(Demonstration- 5 Marks, Principle and Procedure- 4 Marks and Result- 1 Mark)

III. Conduct or identify the test C. Record and interpret the result. 06 Marks

(RPR test / HCG test **/** Indole production test / Methyle red test / Citrate utilization test / TSI test / Nitrate reduction / Urease production / Catalase test)

(Conduct / Identification- 3 Marks, Result- 1 Mark, Interpretation- 2 Marks)

IV. Write critical notes on D, E and F. 3x3=09 Marks

(Karl Landsteiner, Paul Ehrlich, thymus, lymph node, bone marrow, EMB Agar, blood agar, McConkey agar, Mannitol salt agar, *Mycobacterium tuberculosis, Treponema pallidum, Salmonella typhi,* HepatisisB virus*,* HIV*, Candida albicans, Plasmodium*)

(Identification- 1 Mark and Critical comments- 2 marks)

V. Viva-voce 05 Marks

QUESTION PAPER PATTERN OF PRACTICAL EXAMINATION

VI SEMESTER

PRACTICAL-VI: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

Duration: 3 hours **Max. Marks: 40**

I. Demonstrate or perform the experiment A giving principle and procedure. Record the result. 10 Marks

II. Perform or demonstrate the experiment B giving principle and procedure. Record the result. 10 Marks

III. Conduct or identify the test C. Record and interpret the result. 06 Marks

IV. Write critical notes on D, E and F. 3x3=09 Marks

V. Viva-voce 05 Marks

THEORY EXAMINATION QUESTION PAPER PATTERN FOR MAJOR SUBJECTS

(Semesters I –VI)

B.Sc. Degree Examination; 2024-25

(Semester Scheme; New Syllabus: 2024-25)

SUBJECT: MICROBIOLOGY

Paper:

Paper Code:

Time: 3 Hours **Max. Marks: 80**

Instructions to candidates:

1) All sections are compulsory
2) Draw neat and labelled diagrams wherever necessary.

SECTION-A

1. Answer **all** the following questions: **(2×10=20)**

a)
b)
c)
d)
e)
f)
g)
h)
i)
j)

SECTION-B

Answer any **SIX** of the following: **(5×6=30)**

2.
3.
4.
5.
6.
7.
8.
9.

SECTION -C

Answer **Any Three** of the following: **(10×3=30)**

10. From Unit-I
11. From Unit-II
12. From Unit-III
13. From Unit-IV

THEORY EXAMINATION QUESTION PAPER PATTERN FOR ELECTIVE/SKILL PAPERS

(Semesters III &IV)

B.Sc. Degree Examination; 2024-25

(Semester Scheme; New Syllabus: 2024-25)

SUBJECT: MICROBIOLOGY

Paper –ELECTIVE/SKILL PAPER:

Paper Code:

Time: 2 Hours **Max. Marks: 40**

Instructions to candidates:

1) All sections are compulsory
2) Draw neat and labelled diagrams wherever necessary.

SECTION-A

Answer **all** the following questions: **(2×5=10)**

1.
2.
3.
4.
5.

SECTION-B

Answer **any SIX** of the following: **(5×6=30)**

6.
7.
8.
9.
10.
11.
12.
13.

———