



UNIVERSITY OF CALICUT

Abstract

General and Academic - Faculty of Science - Syllabus of BSc Microbiology Programme under CBCSS UG Regulations 2019 with effect from 2019 Admission onwards - Implemented- Orders Issued.

G & A - IV - J

U.O.No. 9836/2019/Admn

Dated, Calicut University.P.O, 25.07.2019

- Read:-*1. U.O.No. 4368/2019/Admn dated 23.03.2019
2. Minutes of the meeting of the Board of Studies in Microbiology held on 08.04.2019
3. Item No. I.10 in the minutes of the meeting of Faculty of Science held on 27.06.2019
4. U.O.No. 8860/2019/Admn dated 05.07.2019

ORDER

The Regulations for Choice Based Credit and Semester System for Under Graduate (UG) Curriculum-2019 (CBCSS UG Regulations 2019) for all UG Programmes under CBCSS-Regular and SDE/Private Registration w.e.f. 2019 admission has been implemented vide paper read first above .

The meeting of Board of Studies in Microbiology held on 08/04/2019 has approved the Syllabus of B Sc Microbiology Programme in tune with the new CBCSS UG Regulations with effect from 2019 Admission onwards, vide paper read second above.

The Faculty of Science at its meeting held on 27/06/2019 has approved the minutes of the meeting of the Board of Studies in Microbiology held on 08/04/2019, vide paper read third above.

Under these circumstances , considering the urgency, the Vice Chancellor has accorded sanction to implement the Scheme and Syllabus of B Sc Microbiology Programme in accordance with new CBCSS UG Regulations 2019, in the University with effect from 2019 Admission onwards, subject to ratification by the Academic Council.

The Scheme and Syllabus of BSc Microbiology Programme in accordance with CBCSS UG Regulations 2019, is therefore implemented in the University with effect from 2019 Admission onwards.

Orders are issued accordingly. (Syllabus appended). The U.O read as (4) above earlier issued in this regard stands cancelled.

Biju George K

Assistant Registrar

To

The Principals of all Affiliated Colleges

Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE IV/DoA/EX and EG Sections/GA I F/CHMK Library/Information Centres/SF/DF/FC

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT



**B.SC. MICROBIOLOGY
SYLLABUS**

(2019 Admission onwards)

Scheme of Evaluation for B.Sc. Microbiology CBCSS (2019 Admission Onwards)

Semester	Course nature	Course code	Course title	Hours/week	Credits	Total credits	Scheme of Evaluation (in		
							Internal (20%)	External (80%)	Total
I	Common English course I	A01		4	4	18	20	80	100
	Common English course II	A02		5	3		15	60	75
	Additional language course I	A07(3)	Communication skill in the languages other than English for B.Sc alternate pattern	5	4		20	80	100
	Core course I	MBG1B01	General Microbiology	3	3		15	60	75
	Ist Complementary	--1C01		2	2		15	60	75
	Ist Complementary - Practical	--4C08(P)		2					0
	2nd Complementary	MBG1C02	Biostatistics I	4	3		15	60	75
II	Common English course III	A03		4	4	20	20	80	100
	Common English course IV	A04		5	3		15	60	75
	Additional language course II	A09(3)	Literature in languages other than English for B.Sc. Alternate pattern	5	4		20	80	100
	Core course II	MBG2B02	Microbial Physiology and Taxonomy	3	3		15	60	75
	Ist Complementary	--2C03		2	2		15	60	75
	Ist Complementary - Practical	--4C08(P)		2	*			0	
	2 nd Complementary	MBG2C04	Biostatistics II	4	3		15	60	75
III	General course I	A11	General Course I (LRP pattern)	4	4	16	20	80	100
	General course II	A12	General Course II (LRP pattern)	4	4		20	80	100
	Core course III	MBG3B03	Environmental and Sanitation Microbiology	4	4		20	80	100
	Core practical course I	MBG4B05(P)	Microbiology Practical I	3	*				0
	Ist Complementary	--3C05		3	2		15	60	75
	Ist Complementary - Practical	--4C08(P)		2	*				0
	2 nd Complementary	MBG3C06		3	2		15	60	75
	2 nd Complementary-Practicals	MBG4C10(P)		2	*				0

Semester	Course nature	Course code	Course title	Hours/week	Credits	Total credits	Scheme of Evaluation (in		
							Internal (20%)	External (80%)	Total
IV	General course III	A13	General Course III (LRP pattern)	4	4	26	20	80	100
	General course IV	A14	General Course IV (LRP pattern)	4	4		20	80	100
	Core course IV	MBG4B04	Soil and Agricultural Microbiology	4	4		20	80	100
	Core course Practical I	MBG4B05(P)	Microbiology Practical I	3	4		20	80	100
	Ist Complementary	--4C07		3	2		15	60	75
	Ist Complementary - Practical	--4C08(P)		2	4		20	80	100
	2 nd Complementary	MBG4C09		3	2	15	60	75	
	2 nd Complementary- Practicals	MBG4C10(P)		2	2	15	60	75	
V	Core course V	MBG5B06	Industrial Microbiology	4	4	18	20	80	100
	Core course VI	MBG5B07	Food and Dairy Microbiology	4	4		20	80	100
	Core course VII	MBG5B08	Immunology	4	4		20	80	100
	Core course VIII	MBG5B09	Medical Microbiology-I	4	3		15	60	75
	Core course practical II	MBG6B12(P)	Microbiology Practical II	4	*				0
	Project work	MBG6B16 (Pr)	Project Work	3	*				0
	Open course-for other departments	MBG5D01	Open course- for other departments	2	3		15	60	75
	MBG5D02	Open course- for other departments							
	MBG5D03	Open course- for other departments							
VI	Core course IX	MBG6B10	Genetics and genetic engineering	4	4	22	20	80	100
	Core course X	MBG6B11	Medical Microbiology-II	4	4		20	80	100
	Core course practical II	MBG6B12(P)	Microbiology Practical II	4	4		20	80	100
	Core course practical III	MBG6B13 (P)	Microbiology Practical III	4	3		15	60	75
	Core course practical IV	MBG6B14 (P)	Microbiology Practical IV	3	3		15	60	75
	Elective course	MBG6B15 (E1)	Cell and Tissue culture	4	2			15	60
		MBG6B15 (E2)	Molecular Biology						
MBG6B15 (E3)		Bioinstrumentation							
Project work	MBG6B16 (Pr)	Project work (Examination along with the core practical examination)	2	2		10	40	50	
					120	120	640	2560	3200

*Credits after exam at the end of semester IV/VI, Ability enhancement courses as per the regulations is mandatory for the completion of the programme

Scheme of Evaluation for B.Sc. Microbiology CBCSS

Distribution of different courses and their credits

Semester	Course type	No.of Courses	Credits	Marks
I and II	Common-English	4	14	350
I and II	Common-Addl language	2	8	200
III and IV	General Common	4	16	400
I to IV	Complementary	11	24	775
I to VI	Core	14	53	1400
V	Open (Other dept.)	1	3	75
V through VI	Project (core)	1	2	50
Total		37	120	3200

I through IV Ability enhancement Courses 4 16

Total common courses offered	:	10
Total core courses offered in the area of specialization (Microbiology) including project work and practical	:	16
Total Complementary courses offered including practicals (two complementary subjects)	:	11
Total courses offered in 6 semesters	:	37
Total credits aquired through class room study	:	120
Total credits required for qualifying Degree	:	140
Total credits offered for core, complementary and open put together	:	82
Total credits required for common courses	:	38

General Course offered (Designed by the Board of studies)

1. General course I - IV for LRP group IV : 16 credits

Open courses offered to students of other Departments with credits (5th Semester)

1. Public health and emerging microbial diseases : 3 credits

2. Environmental Microbiology : 3 credits

Elective from the parent department with credits (6th Semester)

1. Cell and tissue culture : 4 credits

2. Molecular Biology : 4 credits

3. Bioinstrumentation : 4 credits

Complementary Courses for B.Sc. Microbiology

1st Complementary -Biochemistry : 12 Credits

2nd Complementary- Biostatistics and Computer Applications : 12 Credits

Scheme of Examination, Evaluation and Grading:

- There shall be University examinations at the end of each semester.
- Practical examinations shall be conducted by the university at the end of even semesters.
- Practical examination, project / dissertation evaluation and viva voce shall be conducted by one external examiner and one internal examiner appointed by the university.
- Project evaluation shall be conducted at the end of 6th semester.
- Each Practical examination shall be conducted in two consecutive days of six hours duration.
- Evaluation and grading are in accordance with the general guidelines given by the university.
- The questions should be answered only in English

SEMESTER III MBG3C06 Computer Applications- Fundamentals*

SEMESTER IV MBG4C09. C-Language, Data Base Management System & SQL*

 MBG4C10 (P) Computer Applications Practical II (with exam)*

*The syllabus modification of the 2nd complementary may be done by the BOS of Computer science and Statistics

CORE COURSE

MICROBIOLOGY

SEMESTER I

MBG1B01. GENERAL MICROBIOLOGY

3 Hrs /week

3 credits

- Unit 1. Scope and history of Microbiology, spontaneous generation vs. biogenesis. Contributions of the following scientists in various areas of Microbiology - Anton van Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Martinus W. Beijerinck, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman. Beneficial and harmful microbes.
- Unit 2. Eukaryote and prokaryote - differences. Differences between archaeobacteria and eubacteria. Bacterial forms and arrangement of cells. Actinomycetes, Mold and yeast forms. Viral and bacteriophage forms.
- Unit 3. Ultrastructure of bacteria- External structures-glycocalyx, capsule, flagella, fimbriae and pili. Cell-wall: Composition and detailed structure of gram positive and gram-negative cell walls, Archaeobacterial cell wall, sphaeroplasts, protoplasts, and L-forms. Effect of penicillin and lysozyme on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation.
- Unit 4. Microscopy- bright field, dark field, phase contrast, fluorescent and electron microscopy. Staining techniques- simple, negative, Grams, spore, flagella, acid fast, volutin, capsule and Fuelgen staining.
- Unit 5. Sterilisation and disinfection techniques- Physical and chemical methods- flaming, boiling, autoclaving, inspissation, Heat, Filtration, Radiation. Aseptic methods- laminar air flow hood. Disinfectants and its testing.

Suggested Readings

1. Fundamentals of Bacteriology by A.J Salle
2. Microbiology by Pelczar *et al*
3. Fundamentals of Microbiology by Mertus Frobisher
4. General microbiology by Stanier *et al*
5. Text book of Microbiology by Prescott.
6. Principles of Microbiology by Ronald Atlas
7. Microbiology: An Introduction by Tortora GJ, Funke BR, and Case CL.
8. Microbiology: Principles and Explorations *by Black*.
9. Brock Biology of Micro-organisms.
10. Alcamos Fundamentals of Microbiology

SEMESTER II

MBG2B02. MICROBIAL PHYSIOLOGY AND TAXONOMY

3 Hrs /week

3 credits

- Unit 1. Microbial growth: Effect of various parameters and Environmental factors on microbial growth- Temperature, pH, O₂, solute concentration and other factors. Classification based on specific requirement-based on temperature, pH, O₂ and solute concentration. Nutritional requirements of bacteria- C, electron, energy, and minerals. Nutritional types of bacteria- based on the requirement and their combinations. Modes of bacterial nutrition. Transport of nutrients by bacteria- passive, active and group translocation. symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron.
- Unit 2. Culture media-Solid and liquid media, use of agar. Selective, Enrichment, Enriched, differential, selective-differential, indicator media, Transport media, simple and complex, synthetic or defined, Anaerobic media. Culture methods-Streak, spread, pour plate methods, stab culture and lawn culture. Cultivation of aerobic and anaerobic bacteria. Culture preservation strategies.
- Unit 3. Modes of reproduction in bacteria- fission, budding, fragmentation, sporulation. Growth curve and its significance, generation time, steady state culture, synchronous culture and Diauxic culture. Quantitative measurement of bacterial growth by direct and indirect methods. Viral growth- lytic and lysogenic stage. Viral cultivation methods. Viral and bacteriophage quantitation methods- Plaque and pock assay.
- Unit 4. Basics of microbial taxonomy- concept of species and taxa and strain. Classification systems- Numerical taxonomy or Adansonian classification, phenetic and phylogenetic Classification. Various criteria used in bacterial classification:- classical, morphological, physiological, metabolic and ecological characteristics. Molecular characteristics- comparison of proteins, nucleic acid base composition, nucleic acid hybridization and nucleic acid sequencing, 16 S rRNA studies.

Suggested Readings

1. Fundamentals of Bacteriology by A.J Salle
2. Microbiology by Pelczar *et al*
3. Fundamentals of Microbiology by Mertus Frobisher
4. General microbiology by Stanier *et al*
5. Text book of Microbiology by Prescott.

6. Principles of Microbiology by Ronald Atlas
7. Microbiology: An Introduction by Tortora GJ, Funke BR, and Case CL.
8. Microbiology: Principles and Explorations by Black.
9. Brock Biology of Micro-organisms.
10. Lippincotts illustrated reviews microbiology by Harvey
11. Alcamos fundamentals of microbiology
12. Moat AG and Foster JW. (2002). *Microbial Physiology*. 4th edition. John Wiley & Sons.
13. Reddy SR and Reddy SM. (2005). *Microbial Physiology*. Scientific Publishers India.

SEMESTER III

MBG3B03. ENVIRONMENTAL AND SANITATION MICROBIOLOGY

4 Hrs /week

4 credits

- Unit 1. Microbiology of air - atmospheric layers, organisms in air, distribution and sources. Disease forecasting in plants. Indoor and outdoor air. Droplet nuclei, aerosol, infectious dust. Microbiological sampling of air - gravity slide, plate exposure, vertical cylinder, Hirst spore trap, Rotorod sampler, Andersen sampler, hand held air sampler, impingers and filtration. Advantages and disadvantages of these techniques. Brief account of air borne transmission of harmful microbes and air borne infections.
- Unit 2. Aquatic Microbiology: Aquatic environment, distribution of microorganisms in aquatic environment - fresh water, estuarine and marine water systems. Factors influencing growth and distributions. Water Purification procedures for single dwelling and municipal water supplies, Concept of indicator organisms, Microbiological examination of water. BOD, COD, Waste water treatment steps and methods. Eutrophication and algal bloom. Brief account of water borne diseases and transmission.
- Unit 3. Solid waste management: Sources and types of solid waste, need for management, Landfills, composting, vermi- composting, anaerobic digesters, methanogenesis and production of biogas. Design and management of biogas plant.
- Unit 4. Xenobiotic metabolism - Novel pollutants, persistence and biomagnification, Recalcitrant halocarbons- nitroaromatic compounds, PCB, alkyl benzyl sulphonates, and petroleum hydrocarbons - their biodegradation. Bioremediation of polluted environment - Oil spills, heavy Metals and other xenobiotics. Microbial leaching and corrosion of metals.

Suggested Readings

1. Microbial Ecology by Ronald M. Atlas, Richard Bartha.
2. Microbiology concepts and applications by Pelzar *et al*
3. Microbiology by Prescott.
4. Fundamentals of Microbiology by Mertus Frobisher.
5. A Hand book of water and waste water microbiology by Mara and Niger Horan.
6. Microbiological Examination Methods of Food And Water By Silva

7. Text book of Biotechnology by BD Singh
8. Text book of Microbiology by Chakrabarthy
9. Microbial Ecology. John Wiley & Sons.
10. Campbell RE. (1983). *Microbial Ecology*. Blackwell Scientific Publication, Oxford, England.
11. Maier RM, Pepper IL and Gerba CP. (2009). *Environmental Microbiology*. 2nd edition, Academic Press.
12. Stolp H. (1988). *Microbial Ecology: Organisms Habitats Activities*. Cambridge University Press, Cambridge, England.

SEMESTER IV

MBG4B04. SOIL AND AGRICULTURAL MICROBIOLOGY

Hrs /week 4

4 credits

- Unit 1. Introduction to soil Microbiology - Properties of soil (structure, texture, formation). Types of soil microbes, role of microorganisms in soil fertility; Factors affecting microbial population - moisture, pH, temperature, organic matter, agronomic practices etc.; Soil fertility test.
- Unit 2. Biogeochemical cycle- Role of microorganisms in Carbon, Phosphorous, Nitrogen and sulfur cycles. Humus formation and its significance.
- Unit 3. Biological Interactions - Microbe-Microbe Interactions. Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation. Microbe-Plant Interactions. Roots- Rhizosphere and *Mycorrhizae*, Aerial Plant surfaces, Microbe-Animal Interactions. Role of Microbes in Ruminants, Nematophagous fungi, Luminescent bacteria as Symbiont
- Unit 4. Plant pathology (symptoms, disease cycle and control measures) - Bacterial diseases - Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, bacterial cankers of citrus Fungal disease- Wilt of tomato -*Fusariumoxysporum* Red rot of sugarcane – *Colletotrichumfalcatum*, Early blight of potato –*Alternariasolani*, Wilt of cotton, Viral diseases- Papaya ring spot, tomato yellow leaf curl, banana bunchy top.
- Unit 5. Applications of microbes in agriculture :Biofertilizers. Symbiotic nitrogen fixation - (Rhizobium, Frankia) -Symbiotic nutrient mobilizers - Endomycorrhizae and Ectomycorrhizae. Non symbiotic microbes - Azotobacte. Associative Symbiosis - Azospirillum. Cyanobacteria (Nostoc. Gloeocapsa), Azolla-Anabaena System Bio pesticides- bacterial, fungal and viral, Advantages over the chemical counter parts. Effect of pesticides on soil microflora.

Suggested Readings

1. Microbial Ecology. John Wiley & Sons, Inc., New York 2.
2. Introduction to Soil Microbiology by Alexander, M.(1977). John Wiley & Sons, Inc.,
3. Agricultural microbiology, 2nd edition. Rangaswami G., Bagyaraj D. J. Prentice hall of India.
4. Ronald M. Atlas., Richard Bartha. Microbial Ecology. Benjamin Cummings. 1998

5. Robert, L Tate (1995). Soil Microbiology. First edition, John Wiley and Sons, Inc. New York edition. Pearson Education.
6. Rangaswami G and Mahadevan A (2002). Disease of Crop Plants in India. Fourth edition, PHI Learning (P) Ltd., New Delhi.
7. Subba Rao NS (2004). Soil Microbiology. Fourth edition, Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi.
8. Mishra RR (2004). Soil Microbiology. First edition, CBS Publishers and distributors, New Delhi.
9. Devlin RM. (1975). *Plant Physiology*. 3rd edition, Willard Grant Press.
10. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. *Cambridge University Press*, Cambridge, England.
11. Agrios GN. (2006). *Plant Pathology*. 5th edition. Academic press, San Diego,
12. Lucas JA. (1998). *Plant Pathology and Plant Pathogens*. 3rd edition. Blackwell Science, Oxford.
13. Mehrotra RS. (1994). *Plant Pathology*. Tata McGraw-Hill Limited.
14. Rangaswami G. (2005). *Diseases of Crop Plants in India*. 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
15. Singh RS. (1998). *Plant Diseases Management*. 7th edition. Oxford & IBH, New Delhi.
16. Raina M.Maier. Ian L.Pepper and Charles P.Gerba. (2000)Environmental Microbiology.Academic press California.UK

MBG4B05(P). MICROBIOLOGY PRACTICAL I

Hrs /week 3

Credit 4

1. Introduction to common methods of sterilization and laboratory instruments.
2. Microscope and its maintenance.
3. Simple Staining.
4. Grams staining.
5. Capsule Staining.
6. Spore Staining.
7. Volutin granule staining.
8. Preparation of media (Nutrient broth, Nutrient agar, Blood agar, Chocolate agar, Mc Conkey agar, EMB agar).

9. Motility determination - Hanging drop method, Semisolid agar method
10. Isolation of pure culture by streaking.
11. Enumeration of microbial cells (pour plate and spread plate method).
12. Fungal staining.
13. Fungal culturing.
14. Determination of phenol coefficient.
15. Oligodynamic action of heavy metals on microbes.
16. Effect of temperature on growth of microorganisms.
17. Influence of pH on growth.
18. Bacterial growth curve.
19. Isolation of bacteriophages from sewage.
20. Determination of BOD of water.
21. Air sampling by open plate method.
22. Water quality analysis-preliminary (MPN), confirmed and completed test
23. Isolation of rhizobium and azotobacter.
24. Amonification and nitrification of organic compounds.
25. Demonstration of pigment production on nutrient agar medium (*Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Serratia* species).

SEMESTER V

MBG5B06. INDUSTRIAL MICROBIOLOGY

4 Hrs/Week

4 Credits

Unit 1. Basic Concepts of Fermentations :- Fermentor - Components, Types of fermentors- Batch, Fed- batch, Continuous, liquid state , Solid State fermentors. Control systems in fermentation - sterilization, pH, Temperature, Oxygen and aeration, agitation, foam. Computer applications in fermentation technology.

Unit 2. Industrially important microorganisms - Screening Techniques- Primary and Secondary - Preservation of cultures - Strain improvement- Development of inoculum for various fermentation processes. Media formulations - Water, carbon and nitrogen source, growth factors, precursors, minerals, buffers, aeration, antifoam agents, inhibitors, precursors and inducers.

Unit 3. Downstream processing- Extraction and purification of intracellular and extra cellular products.

Unit 4. Microbial production of Wine, Ethanol. Acetone/ butanol by Clostridium species. Organic acids - Citric acid and Lactic acid, Acetic acid. Enzyme - Alpha amylase by bacteria and fungus. Vitamin B12 by streptomycessp, Antibiotics - Penicillin. Steroid transformations.

Unit 5. Introduction to intellectual property and intellectual property rights - types: patents, copy rights, trade marks, design rights, geographical indications - importance of IPR - patentable and non patentables - patenting life - legal protection of biotechnological inventions - world intellectual property rights organization (WIPO).

Suggested Readings

1. Industrial Microbiology by Prescott and Dunns.
2. Principles of Fermentation Technology. Manual of Industrial Microbiology and Biotechnology by Demain and Devis.
3. Principles of Fermentation Technology by Stanburry and Whitaker
4. Crueger W and Crueger A. (2000). *Biotechnology: A textbook of Industrial Microbiology*. 2nd edition. Panima Publishing Co. New Delhi.
5. Comprehensive Biotechnology by Murray and Moo Yung.
6. Sivakumar PK, Joe MM and Sukesh K (2010). An introduction to Industrial Microbiology. First edition, S.Chand& Company Ltd, New Delhi.
7. Agrawal AK and Pradeep Parihar (2006). Industrial Microbiology. Student edition, Jodhpur.
8. Patel AH (2005). Industrial Microbiology. Published by Mac Millan India Ltd., Chennai

9. Stanbury PF, Whitaker A and Hall SJ (1997). Principles of Fermentation Technology. Second edition, Pergmon Press.
10. LE Cassida JR (2005). Industrial Microbiology. New Age International (P) Ltd., New Delhi.

MBG5B07. FOOD AND DAIRY MICROBIOLOGY

4 Hrs/Week

4 Credits

- Unit 1. Food as a substrate for microorganisms. Types of microorganisms in food - Source of contamination - Factors influencing microbial growth in foods (extrinsic and intrinsic) Microbial examination of food- viable colony count, examination of fecal Streptococci.
- Unit 2. Physical and chemical properties of milk. Milk as a substrate for microorganisms. Types of microorganisms in Milk- bacteria, fungi and yeast. Sources of microbial contamination of milk. Microbiological analysis of milk. Rapid platform tests- organoleptic, Clot on boiling (COB), turntable acidity alcohol test, DMC, sedimentation test and pH. Standard plate count, MBRT.
- Unit 3. Food fermentations: Cheese, bread, yoghurt, idli, fermented pickles and fermented vegetables, Ice cream, - methods and organisms used. SCP, Probiotics and prebiotics.
- Unit 4. General principles underlying spoilage, different kinds of foods, cereals and cereal products - sugar and sugar products - vegetable and fruits - meat and meat products - fish and other sea foods - eggs and poultry - dairy and fermentative products (ice cream/milk/bread/wine).
- Unit 5. Food Poisoning : food borne infections (a) Bacterial: Staphylococcal, Brucella, Bacillus, Clostridium, Escherichia, Salmonella (b) Fungal : Mycotoxins including aflatoxins, ergotism (c) Viral: Hepatitis, (d) Protozoa - Amoebiasis.
- Unit 6. Food preservation : Principles of food preservation - methods of preservation. a. Physical (irradiation, drying, heat processing, pasteurization, chilling and freezing, high pressure and modification of atmosphere) b. Chemical (Sodium benzoate Class I & II). Food Sanitation: Good manufacturing practices - HACCP, Personnel hygiene.

Suggested Readings

1. Food Microbiology by Adams, MR. and Moss, M.O.1995.The Royal Society of Chemistry, Cambridge.
2. Food Microbiology by Frazier, W.C. and Westhoff, D.C.1988.TATA McGraw HillPublishing company ltd., New Delhi.
3. Modern Food Microbiology by Jay, J.M.1987.CBS Publishers and distributors, New Delhi.
4. Basic Food Microbiology by Banwart, G.J.1989.Chapman & Hall New York.
5. A Modern Introduction to Food Microbiology by Board, R.C.1983.Blackwell Scientific Publications, Oxford.

6. Dairy Microbiology by Robinson, R.K.1990. Elsevier Applied Science, London.
7. Food Poisoning and Food Hygiene, Hobbs, B.C. and Roberts, D.1993. Edward Arnold.
8. MICROBIOLOGICAL EXAMINATION METHODS OF FOOD AND WATER by SILVA
9. Lund BM, Baird Parker AC, and Gould GW. (2000). *The Microbiological Safety and Quality of Foods*. Vol. 1-2, ASPEN Publication, Gaithersberg, MD.
10. Gould GW. (1995). *New Methods of Food Preservation*. Blackie Academic and Professional, London.

MBG5B08. IMMUNOLOGY

4 Hrs/week

4 Credits

- Unit 1. Brief History of Immunology: Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff. Structure and function of the lymphoreticular system- composition of blood and lymph and their immunological properties.
- Unit 2. Immune Cells and Organs Structure, Functions and Properties of: Immune Cells - Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs - Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT
- Unit 3. Concept of innate, acquired immunity, Humoral and cell-mediated, natural and artificial immunity. Brief descriptions on mechanisms of innate immunological barriers- phagocytosis and inflammation.
- Unit 4. Antigens - features. Hapten, complete antigen, adjuvants, epitope (antigenic determinants). Factors influencing antigenicity. T dependent and T independent antigens. Role of MHC in antigen presentation- class I and class II, MHC Restriction.
- Unit 5. Basic structure of immunoglobulin - Ig G - Different classes of immunoglobulins and their function. Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic). Clonal selection theory. Production of Polyclonal & Monoclonal antibodies & their application. Hybridoma technology. Complement system- activation and functions.
- Unit 6. Antigen and Antibody Reactions-Agglutination, Precipitation, Complement fixation test, neutralization, opsonization, Gel diffusion techniques, Immunoelectrophoresis, labeled antibodies -RIA, ELISA, Western blotting, Immunofluorescent techniques.
- Unit 7. Hypersensitivity - different types -immediate and delayed - Anaphylaxis, immune complex diseases. Autoimmune diseases - mechanisms and classification. Transplantation immunology- mechanism of graft rejection.
- Unit 8. Development and Causes of Cancer, Tumor Viruses, Oncogenes, Tumor Suppressor genes, Tumor antigens, immune responses to tumors, Cancer Treatment-immunotherapy and molecular approach.

Suggested Readings

1. Abbas AK, Lichtman AH, Pillai S. (2007). *Cellular and Molecular Immunology*. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). *Roitt's Essential Immunology*. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). *Kuby's Immunology*. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). *Janeway's Immunobiology*. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). *Basic and Clinical Immunology*. 2nd edition Churchill Livingstone Publishers, Edinburgh.
6. Richard C and Geiffrey S. (2009). *Immunology*. 6th edition. Wiley Blackwell Publication.
7. Immunology by Coleman et al
8. Fundamental Immunology by Paul W.E. et al
9. Introduction to Immunology John W Kimbal et al
10. Text Book of Microbiology by Ananthanarayanan and Jayaram Panikkar.
11. Immunology by Coleman et al
12. Introduction to Immunology John W Kimbal et al

MBG5B09. MEDICAL MICROBIOLOGY I

Hrs/Week 4

3 Credits

- Unit 1. Infection and disease-definition. Types of infections. Various sources of Infection. Methods of transmission of infections. Factors influencing the virulence of pathogens. Definitions of MID, ID₅₀, MLD, LD₅₀, bacteremia, Septicemia, contagious epidemic, endemic, pandemic, sporadic and prosodesmic diseases. Epizootic and enzootic.
- Unit 2. Collection and transport of clinical specimens for microbiological examinations
Normal flora of human body.
- Unit 3. Morphology, culture, biochemical, pathogenicity, laboratory diagnosis and prevention of bacterial diseases - *Staphylococcus aureus*, *S.pneumoniae*, *Neisseria gonorrhoeae*.
- Unit 4. Morphology, culture, biochemical, pathogenicity, laboratory diagnosis and prevention of bacterial diseases - *Mycobacterium tuberculosis*, *Corynebacterium diphtheriae*, *Clostridium tetani*, *Bacillus anthracis*.
- Unit 5. Morphology, culture, biochemical, pathogenicity, laboratory diagnosis and prevention of bacterial diseases - *Salmonella typhi*, *Vibrio cholerae*, *Escherichia coli*,

Pseudomonas aeruginosa

Unit 6. Morphology, culture, biochemical, pathogenicity, laboratory diagnosis and prevention of bacterial diseases - *Treponema pallidum*, *Leptospira interrogans*, .. Rickettsial infections.

Suggested Readings

1. Ananthanarayan R and Paniker CKJ. (2005). *Textbook of Microbiology*. 7th edition (edited by Paniker CKJ). University Press Publication.
2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). *Jawetz, Melnick and Adelberg's Medical Microbiology*. 24th edition. McGraw Hill Publication.
3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). *Mims' Medical Microbiology*. 4th edition. Elsevier.
4. Joklik WK, Willett HP and Amos DB (1995). *Zinsser Microbiology*. 19th edition. Appleton- Century-Crofts publication.
5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education.
6. *Medical Microbiology* : David Greenwood, Slack, Peutherer
7. Satish Gupte (2005). *The Short Textbook of Medical Microbiology*. Eighth edition, Jaypee Brothers, Medical publishers (P) Ltd., New Delhi.
8. Baron EJ, Peterson LR and Finegold SM (1994). *Bailey and Scotts diagnostic Microbiology*. 9th edition, Mosby publications.
9. Rajan S (2009). *Medical Microbiology*. First edition, MJP Publishers, Chennai.
10. Rajesh Bhatia and Ratan Lal Ichhpujani (2004). *Essentials of Medical Microbiology*. Third edition, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.
11. *Medical Microbiology* by Macie and McCartney

SEMESTER VI

MBG6B10. GENETICS AND GENETIC ENGINEERING

4 Hrs/week

4 Credits

- Unit 1. Mendelian Genetics and its Extension: Principles of Inheritance, Chromosome theory of inheritance, Laws of Probability, Pedigree analysis, Incomplete and co dominance, Aneuploidy and Polyploidy, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex linked inheritance. Extra chromosomal inheritance.
- Unit 2. Linkage, Crossing Over gene transfer and Chromosomal Mapping: Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence. Gene transfer techniques in prokaryotes and its utility in gene mapping- conjugation, transformation, transduction, interrupted mating techniques.
- Unit 3. Cell cycle and its regulation. Mitosis and meiosis. Check points and its significance. Programmed Cell death.
- Unit 4. A concise account of methods used in "Recombinant DNA" technology - brief account of cell disruption techniques, Enzymes involved in genetic engineering, vectors, gene transfer techniques, separation techniques and screening strategies.
- Unit 5. DNA Sequencing. DNA Amplification- PCR, applications of PCR. Blotting techniques, DNA (Gene) libraries, application of genetic engineering technology- Gene therapy. GM foods, modified plant and animal varieties, terminator gene technology. Ethical problems associated with the use of r DNA technology.

Suggested Readings

1. Molecular Biology of the Gene by Watson, JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AAM, 1987. The Benjamin/Cummings publishing company.
2. Genes V by Lewin B, 1994. Oxford University press.
3. Molecular Cell Biology by Lodish, H, Baltimore D, Berk A, Zipursky SL, Matsudaira P, Darnell J., 1995. Scientific American Books.
4. Molecular Biology by Freifelder D., 1991 Narosa Publishing Home.
5. Principles of Gene Manipulation, 4th Ed., by R.S.Old and S.B.Primrose. 1989.Blackwell Scientific Publications, London.
6. Biochemistry by Stryer L.,1995. W.H. Freeman and company.
7. Principles of Genetics by Gardner EJ, Simmons MJ, Snustad DP, 1991. John Wiley& Sons.

8. Genes and Genomes by Singer M, Berg P.,1991 University Science Books.
9. Alcamo IE. (2001). *DNA Technology: The Awesome Skill*. 2nd edition. Elsevier Academic Press, Brown TA. (2006). *Gene Cloning and DNA Analysis*. 5th edition. Blackwell Publishing, Oxford,
10. Clark DP and Pazdernik NJ. (2009). *Biotechnology-Appling the Genetic Revolution*. Elsevier Academic Press, USA.
11. Glick BR and Pasternak JJ. (2003). *Molecular Biotechnology*. 3rd edition. ASM Press Washington D.C.
12. Nigam A and Ayyagari A. (2007). *Lab Manual in Biochemistry, Immunology and Biotechnology*. Tata McGraw Hill, India.
13. Primrose SB and Twyman RM. (2006). *Principles of Gene Manipulation and Genomics*, 7thedition. Blackwell Publishing, Oxford, U.K.
14. Sambrook J, Fritsch EF and Maniatis T. (2001). *Molecular Cloning-A Laboratory Manual*. 3rd edition. Cold Spring Harbor Laboratory Press.
15. Willey JM, Sherwood LM, and Woolverton CJ. (2008) *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education.
16. Text book of biochemistry by Satyanarayana
17. Text book of Biochemistry by DM. Vasudeven BT 408:

MBG6B11. MEDICAL MICROBIOLOGY II

4 Hrs/Week

4 Credits

- Unit 1. Viral diseases (with reference to symptoms, pathogenesis, *transmission*, prophylaxis and control) Polio, Chicken pox, Hepatitis, Rabies, Influenza, AIDS , with brief description of bird and swine flu, Dengue. An overview of emerging viral diseases: Japanese Encephalitis, SARS, Chikungunya.
- Unit 2. Fungal diseases - brief account on superficial, subcutaneous and deep mycoses (systemic), opportunistic mycoses, Laboratory diagnosis of fungal infections.
- Unit 3. Protozoan diseases - amoebiasis and malaria. Helminth infections - Tapeworm - *Taenia solium* and *Taenia saginata*, Hook worm - *Ancylostoma duodenale*, Round worm - *Ascaris lumbricoides* and filariasis - *Wuchereria bancrofti*. Flagellates *Trypanosoma brucei gambiense*, *Giardia lamblia* Laboratory diagnosis of parasitic infections.
- Unit 4. Immunoprophylaxis - vaccines - history and development. Different types - live, killed, subUnit, toxoids, bacterial, viral etc. Different routes of administration - oral and parenteral - advantages and disadvantages (eg: BCG, OPV & IPV, DPT, MMR, TAB - brief account).
- Unit 5. Antibiotics: Classification of antibiotics, mode of actions. Introduction to various

generations of antibiotics, emergence and mechanism of resistance.

Suggested Readings

1. Ananthanarayan R and Paniker CKJ. (2005). *Textbook of Microbiology*. 7th edition (edited by Paniker CKJ). University Press Publication.
2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). *Jawetz, Melnick and Adelberg's Medical Microbiology*. 24th edition. McGraw Hill Publication.
3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). *Mims' Medical Microbiology*. 4th edition. Elsevier.
4. Joklik WK, Willett HP and Amos DB (1995). *Zinsser Microbiology*. 19th edition. Appleton- Century-Crofts publication.
5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education.
6. *Medical Microbiology* : David Greenwood, Slack, Peutherer
7. Satish Gupte (2005). *The Short Textbook of Medical Microbiology*. Eighth edition, Jaypee Brothers, Medical publishers (P) Ltd., New Delhi.
8. Baron EJ, Peterson LR and Finegold SM (1994). *Bailey and Scotts diagnostic Microbiology*. 9th edition, Mosby publications.
9. Rajan S (2009). *Medical Microbiology*. First edition, MJP Publishers, Chennai.
10. Rajesh Bhatia and Ratan Lal Ichhpujani (2004). *Essentials of Medical Microbiology*. Third edition, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.
11. *Medical Microbiology* by Macie and McCartney.
12. *Viral Ecology* By Hurs

MBG6B12 (P). MICROBIOLOGY PRACTICAL II

Hrs/week 4

Credits 4

1. Biochemical reactions for identification of various groups of bacteria.
2. Identification of bacterial isolates from clinical samples.
3. Antibiotic sensitivity test.
4. Differential count of leukocytes.
5. Lymphocyte isolation.
6. Blood grouping.
7. WIDAL agglutination test.
8. ASO latex agglutination test.
9. RA latex agglutination test.

10. RPR test.

MBG6B13 (P). MICROBIOLOGY PRACTICAL III

Hrs/week 4

Credits 3

1. Preparation of buffers
2. Demonstration of mitosis.
3. Isolation of genomic DNA from *E.coli*.
4. Estimation of DNA.
5. Isolation of RNA.
6. Estimation of RNA.
7. β -galactosidase induction.
8. Conjugation
9. Transformation
10. Agarose gel electrophoresis of DNA
11. Restriction digestion of DNA

MBG6B14 (P). MICROBIOLOGY PRACTICAL IV

3 Hrs/week

3 Credits

1. Differences in abrupt and gradual scale up of inoculum.
2. Enrichment of coir pith degraders.
3. Sterilization problems with suspended solids in media.
4. Demonstration of SSF, fixed bed and fluidized bed systems.
5. Pellicle formation.
6. Cell disruption techniques.
7. Salting out.
8. Production of alcohol from fruit juice.
9. Microbiological assay of penicillin.
10. Production of citric acid using *Aspergillus*.
11. Isolation and screening of industrially important microorganisms from soil/environment - cellulose digesting, amylase producing.
12. Aerobic mesophilic count of milk.
13. Isolation of microbial flora of fermented milk.
14. Production of wine.
15. Methylene blue reduction test.

MBG6B15 (E1). CELL AND TISSUE CULTURE**4 Hrs/Week****2 Credits**

- Unit 1. Laboratory cultivation of plant and animal cells and tissue culture. Application of plant and animal cell and tissue culture. Basic laboratory requirements, Maintenance of sterile condition Explant selection, sterilization and inoculation
- Unit 2. Different types of culture, Callus culture, Suspension culture, Primary cell culture, Attach dependent cells attach independent cells, Cell lines, Organ culture, Types of media used and its formulations. Role of hormones, Hormones: Auxins, cytokinins, Gibberellins, Abscisic Acid, ethylene. Different media used for plant cell.
- Unit 3. Plant regeneration: organogenesis. Somatic embryogenesis; somaclonal variation, its genetic basis and application in crop improvement. Clonal propagation, production of pathogen - free virus free plants. Plant regeneration Androgenesis; Anther and pollen culture.
- Unit 4. Production of seedless plants, synthetic seeds, Production of secondary metabolites from plant cell suspension culture. Protoplast technology: isolation, culture and plant regeneration, protoplast fusion, identification and characterization of somatic hybrids, applications of protoplast technology. Specific gene transfer: indirect and direct methods.
- Unit 5. Animal cell culture as a substitute for animal experiments. Testing the viability of cells, dye exclusion methods, stem-cell culture and its applications, cell markers characterising stem cells.

Suggested Readings

1. Culture of animal cells - R.Ian Freshney 4th edition John Wiley and Sons.
2. Genetic engineering, Molecular biology and tissue culture of crop pest and disease management - P.Vidhyasekaran, Paya Publication.
3. Animal cell reactors – Chesters Ho & Daneil IC Wang- Butter worth Heinemann.
4. Plant Molecular Biology 2nd Ed: D. Grierson, S.N. Covey. Chapman & Hall.

MBG6B15 (E2). MOLECULAR BIOLOGY**4 Hrs/Week****2 Credits**

- Unit 1. DNA: DNA as the genetic material, Experimental proof. Structure of DNA and RNA, Types and forms – DNA, t-RNA, r-RNA, m-RNA - Definition and functions. Organization of bacterial and eukaryotic chromosomes. Histones and their function.

Denaturation and renaturation, cot curves. DNA topology - linking number, topoisomerases.

Unit 2. Replication of Prokaryotic and eukaryotic DNA. Semiconservative replication of DNA. Models of replication- D-Loop, rolling circle and theta model. Mutations :Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy. Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations, Molecular basis of Mutations in relation to UV light and chemical mutagens, Detection of mutations-Ames test, Replica plating. Concept of Luria Delbrukii experiment. General DNA repair mechanisms.

Unit 3. Transcription- prokaryotic and eukaryotic. Post transcriptional modifications. Translation- prokaryotes and eukaryotes, Genetic code. Post translational modifications. Brief account of gene regulation in prokaryotes – operon concept – lac and trp operon.

Suggested Readings

1. Text book of Biochemistry by Lehninger
2. Biochemistry by Stryer
3. Molecular Biology of the Gene by Watson, JD, Hopkins NH, Roberts JW, Steitz JA,
4. Weiner AAM, 1987. The Benjamin/Cummings publishing company.
5. Genes V by Lewin B, 1994. Oxford University press.
6. Molecular Cell Biology by Lodish, H, Baltimore D, Berk A, Zipursky SL, Matsudaira P,
7. Darnell J., 1995. Scientific American Books.
8. Molecular Biology by Freifelder D., 1991 Narosa Publishing Home.
9. Principles of Gene Manipulation, 4th Ed., by R.S.Old and S.B.Primrose. 1989. Blackwell Scientific Publications, London
10. Cell biology by Karp

MBG6B15 (E3). BIOINSTRUMENTATION

4 Hrs/Week

2 Credits

Unit 1. Centrifugation: principle, types, preparative, analytical and ultracentrifuge. Electrochemical techniques: Principles of electrochemical techniques, redox reactions, the pH electrode, Biosensors.

Unit 2. Spectroscopic techniques: Properties of electromagnetic radiation, instrumentation and applications of UV and Visible spectroscopy, Spectrofluorimetry, atomic spectroscopy, NMR spectroscopic, MALDI-TOF, turbidometry and nephelometry

Unit 3. Chromatographic techniques: Principles, instrumentation and applications of different types of chromatography, HPLC, HPTLC, FPLC, GC-MS, LC-MS, Spectrophotometry: visible and UV spectrophotometry.

Unit 4. Electrophoresis: Principles, instrumentation and applications of different types of electrophoretic techniques, (gel, agarose, SDS-PAGE, pulse field) Isoelectric focusing.

Unit 5. Radio isotope techniques: The nature of radioactivity, types and rate of radioactive decay, detection and measurement of radioactivity, principle, instrumentation and applications of Geiger Muller counter, solid and Liquid Scintillation counter- autoradiography, Flowcytometry

Suggested Readings

1. Keith Wilson and John Walker. Practical Biochemistry- principles and techniques; Cambridge University press, London, UK. 2.
2. David T Plummer, Tata McGraw- Hill publishing company limited; McGraw office, New Delhi
3. C.R. Kothari, 2 nd Edition, 2004. Research methodology- methods and techniques. New Age International (P) limited publishers, New Delhi.
4. Instrumental methods of chemical analysis - P.K. Sharma
5. Biophysical chemistry - Upadhyay., Upadhyay and Nath 6. A Biologist's guide to principle and techniques of practical biochemistry - Brigian L. Williams.
6. Handbook of Biomedical Instrumentation - R.S. Khandpur, Tata McGraw Hill

COMPLEMENTARY COURSE

**BIOSTATISTICS AND COMPUTER
APPLICATIONS**

SEMESTER I

MBG1C02

Biostatistics I SEMESTER II

MBG4C04 Biostatistics

II SEMESTER III

MBG3C06 Computer Applications- Fundamentals

SEMESTER IV

MBG4C09. C-Language, Data Base Management System & SQL.

MBG4C10 (P) Computer Applications Practical II (with exam)

SEMESTER I

MBG1C02. BIOSTATISTICS

4 Hrs/Week

– I

3 credits

Unit 1. Scope of biostatistics – Types of Biological data – Data on Ratio scale – data on interval scale – data on ordinal scale – continuous and discrete data – accuracy and precision. Frequency distribution for a data – Histogram – Frequency Polygon – Cumulative frequency distributions – Ogives. Population and sample – Random sampling – Parameter and Statistics.

Unit 2. Measures of Central Tendency and Measures of Dispersion – Arithmetic mean, Median, Mode, Geometric mean. Range, Mean deviation, Variance, Standard deviation, Quartile deviation, semi interquartile range, coefficient of variation, indices of diversity.

Unit 3. Probability – Random experiment, sample space, events. Probability of events – mathematical definition – addition theorem and multiplication theorem (No proof expected, only problem solving).

Unit 4. Probability distributions. Bernoulli's distribution, Binomial distribution, Poisson distribution, and normal distribution. Parameters of these distributions, mean and variance (no derivations expected). Fitting of these distributions to real data sets.

Unit 5. Distributions derived from normal distribution – t-distribution, chi-square distribution, and F-distributions and their applications.

Reference Books

1. Zar, J. H. Biostatistical Analysis, Fourth Edition (1999), Pearson Education Inc.
2. Gupta and Kapur. Introduction to Mathematical statistics, Sulthan Chand Publications, New-Delhi.

SEMESTER II

MBG2C04. BIOSTATISTICS

4 Hrs/Week

II

3 credits

Unit 1. **Testing of hypotheses:** Statistical hypothesis – Null hypothesis – alternative hypothesis – simple and composite hypothesis. Type I and Type II error. General test procedure - Tests for goodness of fit – contingency table – tests for independence of attributes.

Unit 2. **Analysis of Variance :** One – way and two –way classified data – their mathematical model – analysis of variance – significance testing

Unit 3. **Regression Analysis:** simple linear regression – regression equations – regression coefficients – prediction values of Y – testing the significance of regression – confidence interval in regression - Analysis of variance.

Unit 4. **Simple Correlation:** Simple correlation – calculation of simple correlation from raw data – calculation of correlation from regression coefficients - Testing the presence of correlation - Applications of correlation - Spearman’s Rank correlation.

Unit 5. **Partial and Multiple correlations:** The concept of partial and multiple correlations - its applications. Calculating partial correlation of order one from simple correlations.

Reference Books

1. Zar, J. H. Biostatistical Analysis, Fourth Edition (1999), Pearson Education Inc.
2. Gupta and Kapur. Introduction to Mathematical statistics, Sulthan Chand Publications, New-Delhi.

COMPLEMENTARY COURSE

MICROBIOLOGY

Scheme for B.Sc. Microbiology Complementary Course (CBCSS)- 2019 Admission Onwards

Semester	Course code	Course title	Hours/ week	Credits	Total credits	Scheme of Evaluation (in marks)		
						Internal (20%)	External (80%)	Total
I	MBG1C01	General Microbiology	2	2	2	15	60	75
	MBG4C05 (P)	Microbiology Practical	2					
II	MBG2C02	Applied Microbiology	2	2	2	15	60	75
	MBG4C05 (P)	Microbiology Practical	2					
III	MBG3C03	Food And Industrial Microbiology	3	2	2	15	60	75
	MBG4C05 (P)	Microbiology Practical	2					
IV	MBG4C04	Immunology And Medical Microbiology	3	2	2	15	60	75
	MBG4C05 (P)	Microbiology Practical	2	4	4	20	80	100

SEMESTER 1

MBG1C01. GENERAL MICROBIOLOGY

2hrs/week

Credit 2

- Unit 1. Scope and history of Microbiology, spontaneous generation vs. biogenesis. Contributions of the following scientists in various areas of Microbiology - Anton van Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Alexander Fleming, Selman A. Waksman. Beneficial and harmful microbes.
- Unit 2. Ultrastructure of bacteria- External structures-glycocalyx, capsule, flagella, fimbriae and pili. Cell-wall: Composition and detailed structure of gram positive and gram-negative cell walls, Archaeobacterial cell wall, sphaeroplasts, protoplasts, and L-forms. Effect of penicillin and lysozyme on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids Endospore: Structure, formation, stages of sporulation.
- Unit 3. Microscopy- bright field, dark field, phase contrast, fluorescent and electron microscopy-SEM and TEM. Staining techniques- simple, negative, Grams, spore, flagella, acid fast, volutin, capsule and Fielgen staining.
- Unit 4. Sterilisation and disinfection techniques- Physical and chemical methods- flaming, boiling, autoclaving, inspissation, Heat, Filtration, Radiation. Aseptic methods- laminar air flow hood. Disinfectants and its testing.

Suggested Readings

1. Fundamentals of Bacteriology by A.J Salle
2. Microbiology by Pelczar *et al*
3. Fundamentals of Microbiology by Mertus Frobisher
4. General microbiology by Stanier *et al*
5. Text book of Microbiology by Prescott.
6. Principles of Microbiology by Ronald Atlas
7. Microbiology: An Introduction by Tortora GJ, Funke BR, and Case CL.

8. Microbiology: Principles and Explorations by Black.
9. Brock Biology of Micro-organisms.

SEMESTER II

MBG2C02. APPLIED MICROBIOLOGY

2hrs/week

Credit 2

- Unit 1. Microbial growth: Effect of various parameters and Environmental factors on microbial growth- Temperature, pH, O₂, solute concentration and other factors. Classification based on specific requirement-based on temperature, pH, O₂ and solute concentration. Nutritional requirements of bacteria- C, electron, energy, and minerals. Nutritional types of bacteria- based on the requirement and their combinations. Modes of bacterial nutrition. Growth curve and its significance
- Unit 2. Culture media-Solid and liquid media, use of agar. Selective, Enrichment, Enriched, differential, selective-differential, indicator media, Transport media, simple and complex, synthetic or defined, Anaerobic media. Culture methods-Streak, spread, pour plate methods, stab culture and lawn culture. Cultivation of aerobic and anaerobic bacteria. Culture preservation strategies.
- Unit 3. Air Microbiology: Air microflora-sources, factors affecting air microflora, enumeration of microorganisms in air- settling under gravity, centrifugation, impingement, filtration, electrostatic precipitation, Airborne diseases-bacterial, fungal,viral.
- Unit 4. Water Microbiology: Factors affecting microbial population in natural waters - temperature, light, hydrogen concentration, pressure, salinity, nutrients, turbidity. Purification of water-aeration, sedimentation, coagulation, flocculation, sand filtration. waste water treatment- primary, secondary and tertiary stages. Disinfection of drinking water. Bacteriological techniques for examination of water potability. Indicator organisms, BOD

Suggested readings

1. Brock biology of Microorganisms-Madigam
2. Microbial Ecology by Atlas and Bartha
3. Fundamentals of Bacteriology by A.J .Salley

4. Microbiology by Pelczar *et al*
5. Fundamentals of Microbiology by Mertus Frobisher
6. General microbiology by Stanier *et al*
7. Text book of Microbiology by Prescott.
8. Principles of Microbiology by Ronald Atlas
9. Microbiology: An Introduction by Tortora GJ, Funke BR, and Case CL.
10. Microbiology: Principles and Explorations by Black.

SEMESTER III

MBG3C03 FOOD AND INDUSTRIAL MICROBIOLOGY

3hrs/week

Credit 2

Unit 1. Food Microbiology: Food as a substrate for microorganisms . Microorganisms important in food microbiology -molds, yeast, bacteria. Contamination of foods.

Unit 2. Spoilage of food -chemical changes caused by microorganisms . Spoilage of milk, meat, fish Methods of food preservation: Physical and chemical preservatives. Food poisoning-Bacterial.

Unit 3. Industrial Microbiology: Advantages of microbial process over chemical process, Fermentor- basic functions of a fermentor, structure and working . Batch culture, continuous culture, fed- batch culture. Production of penicillin, vitamin B-12, citric acid and bakers yeast, SCP. Steroid biotransformation .Downstream process.

Suggested readings

1. Industrial Microbiology -A. H. Patel
2. Industrial microbiology -Casida
3. Industrial Microbiology-Prescott & Dunn.
4. Environmental Microbiology- Joseph. C. Daniel
5. Food Microbiology, Fundamentals &Frontiers-Doyle.
6. Food Microbiology-William. C. Frazier

SEMESTER IV

MBG4C04. IMMUNOLOGY AND MEDICAL

2hrs/week

MICROBIOLOGY

Credit 2

Unit 1. Antigens-types, epitopes, haptens, Immunoglobulins: basic structure of immunoglobulin and different types.

Unit 2. Types of infection, Source of infection, Modes of transmission, Factors influencing the virulence of pathogens .Definitions of MID, ID50, MLD, LD50, bacteremia, Septicemia, contagious epidemic, endemic, pandemic, sporadic and prosodemic diseases.

Unit 3. Bacterial diseases caused by -*Staphylococcus aureus*, *Mycobacterium tuberculosis*, *Clostridium tetani*, *Clostridium botulinum*, *Vibrio cholerae*, *Salmonella typhi*.*Treponema pallidum*

Unit 4. Viral diseases - Rabies, AIDS, Hepatitis, An overview of emerging viral diseases: Chikungunya, dengue, H1N1, swine flu.

Unit 5. Fungal diseases- Superficial and deep mycoses, Protozoan diseases- Amoebiasis, Malaria.

Suggested Readings

1. Immunology-Janeway.
2. Immunology-Kuby.
3. Introduction to Microbiology-John. L. Ingraham
4. Introductory Mycology-Alexopoulos.
5. Medical Microbiology-Brooks, Butal, Slack.
6. Medical Microbiology-Ananthanarayanan & Jayaram Panicker.

MBG4C05 (P). MICROBIOLOGY PRACTICAL 2 Hrs/

Week in semesters I to IV

Credit 4

1. Cleaning and sterilization of glassware.
2. Introduction to hot air oven, autoclave and incubator.
3. Microscope and its maintenance.
4. Simple Staining.
5. Grams staining.
6. Capsule Staining.
7. Spore Staining.
8. motility- hanging drop method
9. Preparation of media (Nutrient broth, Nutrient agar,)
10. Use of EMB, Mc Conkey and Blood agar in bacterial charecterisation.
11. Isolation of pure culture by streak plate method.
12. Enumeration of microbial cells (pour and spread plate method).
13. Air sampling.
14. Aerobic mesophilic count of fish samples and milk.
15. Methylene blue reduction test.
16. Pellicle formation.
17. Microbiological analysis of drinking water
18. Biochemical reactions for identification of various groups of bacteria.
19. Antibiotic sensitivity test.
20. WIDAL agglutination.
21. RPR

NB. MB34C05 (P). Exam at the end of Semester IV

OPEN COURSE

MICROBIOLOGY

MBG5D01. PUBLIC HEALTH AND EMERGING MICROBIAL DISEASES

Hrs/Week 2

3 Credits

Unit 1. Concept of health, Dimensions of health, Human development index, Human poverty index, Gender related development index and gender empowerment measure. Determinants of health. Responsibility for health-Individual,Community, State and International responsibility. Indicators of health.

Unit 2. Infectious disease epidemiology. Definition of terms:-infection (primary, secondary, cross, nosocomial, iatrogenic, exogenous, endogenous, clinical , subclinical), contamination, infestation, host, infectious disease, communicable disease, epidemic, pandemic, endemic, sporadic, exotic, zoonotic, epizootic enzootic and epornithic diseases. Sources of infection and modes of transmission. Reservoirs, carriers and vectors of communicable diseases. Role of WHO in pandemic alerts.

Unit 3. Symptomatology, epidemiology, preventive measures of disease- Hepatitis,-A,B,E, HIV, Tuberculosis, Enteric fever, Weil's disease, microbial food poisonings. Emerging diseases- Dengue fever, Chikungunya, Swine flu. Bio-terrorism.

Suggested Readings

1. Ananthanarayan R and Paniker CKJ. (2005). *Textbook of Microbiology*. 7th edition (edited by Paniker CKJ). University Press Publication.
2. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007).*Jawetz, Melnick and Adelberg's Medical Microbiology*. 24th edition. McGraw Hill Publication.
3. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). *Mims' Medical Microbiology*.4th edition. Elsevier.
4. Joklik WK, Willett HP and Amos DB (1995). *Zinsser Microbiology*. 19th edition. Appleton- Century-Crofts publication.
5. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein'sMicrobiology*. 7th edition. McGraw Hill Higher Education.
6. *Medical Microbiology* : David Greenwood, Slack, Peutherer
7. Satish Gupte (2005). *The Short Textbook of Medical Microbiology*. Eighth edition, Jaypee Brothers, Medical publishers (P) Ltd., New Delhi.
8. Baron EJ, Peterson LR and Finegold SM (1994). *Bailey and Scotts diagnostic Microbiology*. 9th edition, Mosby publications.
9. Rajan S (2009). *Medical Microbiology*. First edition, MJP Publishers, Chennai.
10. Abbas AK, Lichtman AH, Pillai S. (2007). *Cellular and Molecular Immunology*.6thedition aunders Publication, Philadelphia.

11. Delves P, Martin S, Burton D, Roitt IM. (2006). *Roitt's Essential Immunology*. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
12. Goldsby RA, Kindt TJ, Osborne BA. (2007). *Kuby's Immunology*. 6th edition W.H. Freeman and Company, New York.

MBG5D02. ENVIRONMENTAL MICROBIOLOGY

2 Hrs/Week

3 Credits

Unit 1. Soil Microbiology: Humus, Microflora of soil, Nitrogen cycle - Nitrogen fixation, nitrification, denitrification. Rhizosphere - Rhizosphere microorganisms.

Unit 2. Faecal pollution of water - waterborne diseases, indicator organisms. Microbiological examination of water. Water purification- aeration, sedimentation, coagulation, flocculation, sand filtration . Disinfection of drinking water , Sewage treatment.

Unit 3. Dispersal of airborne microorganisms, indoor outdoor air Droplet nuclei, aerosol, Air borne diseases.

Unit 4. Global environmental problems: ozone depletion, green house effect and acid rain, their impacts and biotechnological approaches for management. Definition of xenobiotics and biomagnification. composting , vermicomposting and biogas production.

Suggested Readings

1. Microbial Ecology by Ronald M. Atlas, Richard Bartha.
2. Microbiology concepts and applications by Pelzar *et al*
3. Microbiology by Prescott.
4. Fundamentals of Microbiology by Mertus Frobisher.
5. Hand book of water and waste water microbiology by Mara and Niger Horan.
6. Microbiological Examination Methods Of Food And Water By Silva
7. Text book of Biotechnology by BD Singh
8. Text book of Microbiology by Chakrabarthy
9. Microbial Ecology. John Wiley & Sons.
10. Campbell RE. (1983). *Microbial Ecology*. Blackwell Scientific Publication, Oxford, England.
11. Maier RM, Pepper IL and Gerba CP. (2009). *Environmental Microbiology*. 2nd edition, Academic Press.
12. Stolp H. (1988). *Microbial Ecology: Organisms Habitats Activities*. Cambridge University Press, Cambridge, England.

MODEL QUESTION PAPER

MBG3B03. ENVIRONMENTAL AND SANITATION MICROBIOLOGY

Time: 2.5 Hrs.

Maximum: 80 Marks

Wherever needed answers must be supported by structural illustrations and diagrams

Section A

*Short answer type questions: Answer **all** questions
Each question carries 2 marks*

Write briefly on:-

1. Superbug
2. BOD
3. Droplet nuclei
4. Andersen sampler
5. Recalcitrants
6. Trickling filters
7. Bioleaching
8. Coliforms
9. Methanogenesis
10. Biofiltration
11. EMB agar
12. Sulfur-reducing bacteria (SRB)
13. Imhoff tank
14. Aeroallergen
15. MPN

(Maximum: 25 marks)

Section B

*Paragraph type questions: Answer **all** questions
Each question carries 5 marks*

Write notes on:-

1. Microbiology of the composting process
2. Role of activated sludge in waste water treatment process
3. Microbial degradation of Xenobiotics
4. Biogas technology
5. Plant disease forecasting
6. Aerobiology and its role in the transmission of infectious diseases
7. Escherichia coli as an indicator of bacteriological quality of water
8. Air sampling procedures to evaluate microbial contamination

(Maximum: 35 marks)

Section C

*Essay type questions: Answer **any two** questions
Each question carries 10 marks*

Write essay on:-

1. Write the primary, secondary and tertiary treatment process used in wastewater treatment
2. Elaborate on the principle and procedures of microbial analysis of water
3. Explain in detail the process of bioremediation
4. What is solid waste management? Explain in detail the sources and methods of solid waste management.

(Maximum: 2 x 10 = 20 marks)

MODEL QUESTION PAPER

MBG5B08. IMMUNOLOGY

Time: 2.5 Hrs.

Maximum: 80 Marks

Wherever needed answers must be supported by structural illustrations and diagrams

Section A

*Short answer type questions: Answer **all** questions*

Each question carries 2 marks

Write briefly on:-

1. ADCC
2. Opsonization
3. Anaphylaxis
4. Ouchterlony immunodiffusion
5. Autoantigens
6. Hematopoiesis
7. Isograft and allograft
8. T Cell receptor
9. Hapten
10. Complement fixation test
11. Oncogenes
12. Epitope and paratope
13. Interferon (IFNs)
14. NK cell
15. Adaptive Immunity

(Maximum: 25 marks)

Section B

*Paragraph type questions: Answer **all** questions*

Each question carries 5 marks

Write notes on:-

1. Role of MHC in antigen presentation
2. Describe the production of monoclonal antibodies by hybridoma technology.
3. Explain agglutination reaction reactions and its applications
4. Immunology of graft rejection
5. Describe major factors that influence antigenicity
6. Describe the classical pathway of complement activation
7. Explain the process of B-cell activation and differentiation
8. Briefly describe the major organs of the immune system & their function

(Maximum: 35 marks)

Section C

*Essay type questions: Answer **any two** questions*

Each question carries 10 marks

Write essay on:-

1. Describe the structure and biological activities of the immunoglobulin classes
2. Define and classify immunity. Explain the mechanism of innate innate immunity
3. Give an account of autoimmune diseases
4. Discuss in detail on different hypersensitivity reactions

(Maximum: 2 x 10 = 20 marks)

MODEL QUESTION PAPER
MBG6B15 (E2). MOLECULAR BIOLOGY

Time: 2 Hrs.

Maximum: 60 Marks

Wherever needed answers must be supported by structural illustrations and diagrams

Section A

*Short answer type questions: Answer **all** questions
Each question carries 2 marks*

Write briefly on:-

1. TATA box
2. Cot analysis
3. Z-DNA
4. Okazaki fragments
5. Palindromic sequence
6. mRNA capping
7. Ames test
8. Suppressor mutations
9. SOS repair
10. Plasmid
11. D-loop replication
12. t- RNA

(Maximum: 20 marks)

Section B

*Paragraph type questions: Answer **all** questions
Each question carries 5 marks*

Write notes on:-

1. Genetic code and its properties
2. Describe in detail the role of enzymes in DNA replication
3. Post transcriptional modifications
4. Explain the steps involved in prokaryotic translation process
5. Histons and the role of Histone in DNA packaging
6. Hershey–Chase experiment
7. Different types of RNAs and their functions

(Maximum: 30 marks)

Section C

*Essay type questions: Answer **any one** question
Question carries 10 marks*

Write essay on:-

1. Explain the mechanism of regulation of gene express in bacteria in related to *lac-operon*.
2. Describe DNA damage and repair mechanisms

(Maximum: 1 x 10 = 10 marks)