

IKG Punjab Technical University
B.Sc. (Hons) Microbiology Batch 2020 onwards

Semester -1

| Course Code | Course Title | Course Type | Load Distribution | | | Marks Distribution | | Total Marks | Credits |
|--------------|--|---------------------|-------------------|----------|-----------|--------------------|------------|-------------|-----------|
| | | | L | T | P | Int. | Ext. | | |
| BSMB101-19 | Introduction to Microbiology | Core | 3 | 1 | - | 40 | 60 | 100 | 4 |
| BSMB102-19 | Introduction to Microbiology (Lab) | Core Practical | 0 | 0 | 3 | 60 | 40 | 100 | 2 |
| BSMB103-19 | Chemistry-I | Core | 3 | 1 | - | 40 | 60 | 100 | 4 |
| BSMB104-19 | Chemistry-I (Lab) | Core Practical | 0 | 0 | 3 | 60 | 40 | 100 | 2 |
| BSMB105-19 | Cell Biology | Core | 3 | 1 | - | 40 | 60 | 100 | 4 |
| BSMB106-19 | Cell Biology (Lab) | Core Practical | 0 | 0 | 3 | 60 | 40 | 100 | 2 |
| BSMB107-19 | Basics of Biosciences * | Foundation Course * | 2 | 0 | 0 | 20 | 30 | 50 | 0 |
| BSMB108-19 | Basics of Biosciences Lab * | Foundation Course * | 0 | 0 | 2 | 20 | 30 | 50 | 0 |
| BTHU103-18 | English | (AECC) | 2 | 0 | 0 | 40 | 60 | 100 | 2 |
| BTHU104-18 | English Lab | (AECC) Lab | 0 | 0 | 2 | 30 | 20 | 50 | 1 |
| HVPE101-18 | Human Values, De-addiction and Traffic Rules | (AECC) | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| HVPE102-18 | Human Values, De-addiction and Traffic Rules (Lab-seminar) | (AECC) Lab | 0 | 0 | 1 | 25 | - | 25 | 1 |
| BMPD102-18 | Mentoring & Professional Development | | 0 | 0 | 2 | 25 | - | 25 | 1 |
| TOTAL | | | 16 | 3 | 16 | 500 | 500 | 1000 | 26 |

* Basics of biosciences and Basics of Biosciences Lab - For students having passed 10+2 with Mathematics to take compulsory deficiency course and to be awarded Satisfactory and Non- Satisfactory during their final results by PTU. This course is a deficiency course for a specific section of students so no credits have been allotted.

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B.Sc. (Hons) Microbiology Batch 2020 onwards

Second Semester

| Course Code | Course Title | Course Type | Load Distribution | | | Marks Distribution | | Total Marks | Credits |
|--------------|---|----------------|-------------------|----------|-----------|--------------------|------------|-------------|-----------|
| | | | L | T | P | Int. | Ext. | | |
| BSMB201-19 | Bacteriology | Core | 3 | 1 | - | 40 | 60 | 100 | 4 |
| BSMB202-19 | Bacteriology (Lab) | Core Practical | - | - | 3 | 60 | 40 | 100 | 2 |
| BSMB203-19 | Fundamentals of Biochemistry | Core | 3 | 1 | - | 40 | 60 | 100 | 4 |
| BSMB204-19 | Fundamentals of Biochemistry (Lab) | Core Practical | - | - | 3 | 60 | 40 | 100 | 2 |
| BSMB205-19 | Molecular Biology | Core | 3 | 1 | - | 40 | 60 | 100 | 4 |
| BSMB206-19 | Molecular Biology (Lab) | Core Practical | - | - | 3 | 60 | 40 | 100 | 2 |
| BSBMB 207-19 | Microbial Physiology and Metabolism | Core | 3 | 1 | - | 40 | 60 | 100 | 4 |
| BSBMB 208-19 | Microbial Physiology and Metabolism (Lab) | Core Practical | - | - | 3 | 60 | 40 | 100 | 2 |
| BMPD209-18 | Mentoring & Professional Development | | - | - | 2 | 25 | - | 25 | 1 |
| TOTAL | | | 12 | 4 | 14 | 425 | 400 | 825 | 25 |

Third Semester

| Course Code | Course Title | Course Type | Load Allocation | | | Marks Distribution | | Total Marks | Credits |
|-------------|---|------------------------------|-----------------|---|---|--------------------|----------|-------------|-----------|
| | | | L | T | P | Internal | External | | |
| BSMB301-19 | Virology | Core Theory | 3 | - | 0 | 40 | 60 | 100 | 3 |
| BSMB302-19 | Virology Lab | Core Practical | - | - | 4 | 60 | 40 | 100 | 2 |
| BSMB303-19 | Microbial Genetics | Core Theory | 3 | - | 0 | 40 | 60 | 100 | 3 |
| BSMB304-19 | Microbial Genetics Lab | Core Practical | - | - | 4 | 60 | 40 | 100 | 2 |
| BSMB305-19 | Microbes in Environment | Generic Elective | 3 | - | 0 | 40 | 60 | 100 | 3 |
| BSMB306-19 | Microbes in Environment | Generic Elective Practical | - | - | 4 | 60 | 40 | 100 | 2 |
| BSMB307-19 | Microbiological Analysis in Air and Water | Skill Enhancement Elective | 2 | - | 0 | 20 | 30 | 50 | 2 |
| BSMB308-19 | Biostatistics | Discipline Specific Elective | 3 | 1 | 0 | 40 | 60 | 100 | 4 |
| BSMB309-19 | Mentoring and Professional Development | | - | - | 2 | 25 | - | 25 | 1 |
| | | | | | | | | 775 | 21 |

BSMB101-19 Introduction to Microbiology

Unit 1

History of Microbiology: A. Leeuwenhoek, L.Pasteur, R.Koch, J.Lister, J.Tyndall, etc. Biogenesis v/s Abiogenesis, Koch Postulates, Discovery of antibiotics. Principle of Microscopy: Bright field, Dark field, Phase contrast, Fluorescent, Electron Microscopy.

Unit 2

Microbial classification: Bacteria, Fungi and Algae. Morphology of bacteria, viruses, algae and fungi with major emphasis on bacterial structure specially cell wall. Gram positive and Gram negative bacteria. Microbial spores, Sporulation and germination process. Nitrogen fixing microbes in agriculture.

Unit 3

Microbial growth, nutritional biodiversity, phases of growth, generation time, growth rates, monoauxic, diauxic and synchronous growth, chemostat, Microbes in extreme environment like high temperature and high/ low pH Physical and chemical agents to kill microbes, sterilization and pasteurization processes.

Unit 4

Normal micro flora in humans, Types of microbial pathogens and diseases caused by them. Microbial interactions like symbiosis and antibiosis etc. Aerobic and Anaerobic fermentation, production of heterologous proteins in microbes.

Suggested Readings / Books

1. Davis, B.D Dulbecco, R., Eiser, H.N. and Ginsberg, H.S. (1990). Microbiology, 4th edition, Harper and Row, Publishers, Singapore.
2. Tortora, G.J., Funke, B.R., and Case, C.L. (1994). Microbiology: an introduction, 5th edition, the Benjamin/Cummings Publishing Company, Inc.
3. Stanier, R.Y. (1995). General Microbiology, MacMillian Press London.
4. Pelczar, M.T. (1995). Microbiology, Tata McGraw Hill Publication, New Delhi.
5. Schegel, H.G., (1995). General microbiology 7th ed. Cambridge University Press.
6. Prescott and Dunn (1999). Industrial Microbiology, 4th ed. By S.K Jain for CBS Publishers and Distributors.
7. Purohit, S.S. (2000). Microbiology: Fundamentals and Applications (6th edition), Agrobios (India)
8. Postgate, J. (2000). Microbes and Man : 4th ed, Cambridge University Press.

BSMB102-19 Introduction to Microbiology Lab
List of Practical

1. Aseptic techniques
2. Cleaning of glass wares, Preparation of media, Cotton plugging and sterilization
3. Isolation of bacteria from air, water and soil
4. Personal hygiene- Microbes from hands, Tooth-Scum and other body parts.
5. Dilution and pour plating techniques.
6. Growth curve of microorganisms.
7. Culture from body fluids (Stools, Urine, Blood).
8. Alcoholic and mixed acid fermentation.
9. Simple staining.
10. Differential staining- Gram staining
11. Identification of bacteria by Biochemical analysis of bacteria: Oxidase test, catalase test, MR-VP test.
12. Slide identification from permanent slides.

BSMB103-19 Chemistry-I

Unit-1

Atomic Structure : Bohr's atomic model & limitation. Idea of de Broglie matter waves. Heisenberg's uncertainty principle. Schrödinger's wave equation. Significance of wave function. Quantum numbers. Multielectron system-Pauli's exclusion principle, Hund's rules of maximum multiplicity. Stability of half filled full field orbitals, Aufbau principle & its limitation. Electronic configuration of atoms.

Unit-2

Bonding in organic compounds: Classification, trivial names and IUPAC system of nomenclature of organic compounds. Nature of covalent bond and its orbital representation. Hybridization, bond energy, polarity of bond & dipole moment of molecules, inductive effect, hydrogen bond, conjugation, resonance. Homolytic & heterolytic fission of bonds electrophiles & nucleophiles, carbonation, carbon ions and radicals- their stability, geometry & generation.

Unit-3

Stereochemistry: Dissymmetric Molecules: Different types of Isomerism, Structural Isomers, Geometrical, Stereoisomerism, Configurational Isomers, Conformational Isomers, Concept of asymmetric carbon atom, Enantiomers, Diastereoisomers, Stereogenic atom / center, Chirotopic / Achirotopic Centre, Protostereoisomerism, Concept of Topicity of Ligands and Faces (Homotopic, Enantiotopic, Diastereotopic atoms and groups; Prochiral, Homotopic, Enantiotopic, Diastereotopic Faces), Projection Structures of Stereoisomers (Fischer, Sawhorse, Newman, Flying-Wedge projection and Interconversion of these projection formulas) of simple molecules containing one or two asymmetric carbon atom,

Unit-4

Optical isomerism, Optical activity, Element of symmetry and chirality, Meso compounds, Chiral centers and the number of stereoisomers, Racemic mixtures, Racemic mixture or (+/-)-Conglomerate, Racemic Compounds or racemate, Stereochemical nomenclature of Stereoisomers containing chiral centers(R/S and E/Z or cis-trans or sec cis- sec trans of C=C system);D,L system of designation; Pro-R, Pro-S, Re, Si, Erythro, threo, R and S designation of enantiotopic groups and atoms; Chirality of Organic molecules without chiral center and concept of chiral axis.

Suggested Readings / Books

1. J.D. Lee, Inorganic Chemistry, 5th edition Chapman & Hall, London.
2. Inorganic Chemistry by Puri, Sharma and Kalia
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry
4. F. Basalo and R.C. Johnson, Co-ordination Chemistry, 1964.
5. Organic Chemistry – FINAR II
6. Organic Chemistry _ Morrison and Boyd
7. Vogel's text book of Organic Chemistry – Furniss
8. Organic Chemistry – Ege Sezham
9. Atkin's Physical Chemistry by Peter Atkins and Julio de Paula. Publisher Oxford University Press • Textbook of Physical chemistry by Samuel Glasston. MacMillan India Ltd
10. Kalyani Physical Chemistry by K.L. Chug and S.L. Agnish. Kalyani Publisher

BSMB104-19 Chemistry -1 Lab

List of practical's

1. Separation of constituents present in an inorganic mixture containing two cations only (constituents having large difference in Rf values to be provided).
2. Preparation of any one of the following compounds
 - (i). Acetanilide
 - (ii). Aspirin
 - (iii). p-Nitroacetanilide
 - (iv). Aniline yellow or 2 - Naphthol Aniline dye.
3. Qualitative analysis
Determination of one cation and one anion in a given salt.
Cation:- Pb^{2+} , Cu^{2+} , As^{3+} , Al^{3+} , Fe^{3+} , Mn^{2+} , Zn^{2+} , Cu^{2+} , Co^{2+} , Ni^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , NH_4^+
Anions:- CO_3^{2-} , S^{2-} , SO_3^{2-} , SO_4^{2-} , NO_2^- , NO_3^- , Cl^- , Br^- , I^- , PO_4^{3-} , $\text{C}_2\text{O}_4^{2-}$, CH_3COO^-
(Note: Insoluble salts included)
4. Tests for the functional groups present in organic compounds:
Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (Primary) groups.
5. Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given food stuffs.
6. Detection of adulteration in various samples like oil, milk, pulses, spices etc

BSMB105-19 Cell Biology

Unit I Cell as a basic unit of living systems: Cell structure and the cell theory, Broad and detailed classification of cell types within an organism. Different levels of organization of cells.

Unit -2 Cell division and Cell cycle: Cell interaction; Cell locomotion, Muscle and Nerve cells, Cell senescence and death, Cell differentiation.

Unit -3 Structure and function of cell organelles: Ultrastructure of cell membrane, cytosol, golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, Cytoskeletal structures (actin, microtubules etc.), Mitochondria, chloroplasts, lysosomes, peroxisomes. Nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin).

Unit -4 Fixation and Staining; Freeze drying and freeze substitution, Microtome and Embedding, Chemical basis of staining, Cytophotometric Methods.

Suggested Readings / Books

1. Cell and molecular Biology: De Roberties
2. Cell Biology: Bruce Albert's
3. Cell Biology: Dowben

BSMB106-19 Cell Biology Lab

List of Practicals

1. Sub Cellular Fractionation and marker enzymes
2. Mitosis and Meiosis
3. Vital staining for visualizing cell organelles
4. Histochemical Techniques
5. Centrifugation
6. Chromatography-Paper and Thin Layer chromatography
7. Microscopy: Bright field

BSMB107-19 Basics of Biosciences

Unit 1

Diversity in the living world; The living world, Biological classification, Kingdom Monera, Kingdom Protista, Kingdom Fungi, Plant kingdom; Classification of animals in general.

Unit 2

Structural organization in plants; Morphology of flowering plants, Anatomy of plants.

Unit 3

Structural organization in animals; Structural organization in animals: animal tissues, morphology and anatomy of animals.

Unit 4

Cell- Basic unit of life; Cell theory, Cell structure and functions; Cell cycle and cell division; Bio-molecules.

BSMB108-19 Basics of Bioscience Lab
List of Practicals

1. General guidelines for Good lab Practices
2. Description of flowers including floral diagram, floral formula, V.S. of flower of the representative genera of families mentioned in syllabus.
3. Simple staining
4. Tissue sectioning and microscopic analysis
5. Bright field microscopy
6. Each student required to submit a family wise herbarium consisting of at least 20 properly pressed and mounted plants.
7. Identification of animal specimens (chordates and non chordates).

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BTHU103-18 English

Unit-1 (Introduction)

Theory of Communication, Types and modes of Communication, Communication at Workplace.

Unit- 2 (Language of Communication)

Verbal and Non-verbal, Spoken and Written, Personal, Social and Business, Barriers and Strategies, Intra-personal, Inter-personal and Group communication.

Unit-3 (Reading and Understanding)

Close Reading, Comprehension, Summary Paraphrasing, Analysis and Interpretation, Translation (from Hindi/Punjabi to English and vice-versa), Literary/Knowledge Texts, Common Everyday Situations: Conversations and Dialogues.

Unit-4 (Writing Skills)

Documenting, Report Writing, Making notes, Letter writing-Formal and Informal.

Suggested Readings:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas • On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.

IKG Punjab Technical University
B.Sc. (Hons) Microbiology Batch 2020 onwards

BTHU104-18 English Lab

Interactive practice sessions in Language Lab on Oral Communication

- Listening Comprehension
- Self Introduction, Group Discussion and Role Play
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations
- Monologue
- Effective Communication/ Mis-Communication
- Public Speaking

Suggested Readings:

1. Fluency in English -Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
5. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

HVPE101-18 Human Values, De-addiction and Traffic Rules
Ability enhancement Compulsory Course (AECC)

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration—what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels

Module 2: Understanding Harmony in the Human Being - Harmony in Myself

7. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
8. Understanding the needs of Self (‘I’) and ‘Body’ - Sukh and Suvidha
9. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’
11. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail.
12. Programs to ensure Sanyam and Swasthya - Practice Exercises and Case Studies will be taken up in Practice Sessions.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship.

13. Understanding harmony in the Family- the basic unit of human interaction
14. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship
15. Understanding the meaning of Vishwas; Difference between intention and competence
16. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship
17. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals
18. Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha) - from family to world family! - Practice Exercises and Case Studies will be taken up in Practice Sessions.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence.

19. Understanding the harmony in the Nature
20. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self- regulation in nature
21. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space
22. Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions.

IKG Punjab Technical University
B.Sc. (Hons) Microbiology Batch 2020 onwards

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics.

23. Natural acceptance of human values
24. Definitiveness of Ethical Human Conduct
25. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
26. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
27. Case studies of typical holistic technologies, management models and production systems
28. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations

Reference Books

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
5. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.
6. A.N. Tripathy, 2003, Human Values, New Age International Publishers.
7. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
8. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome’s report, Universe Books.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
10. M Govindrajan, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human IK Gujral Punjab Technical University Jalandhar B.Sc. Biotechnology Batch 2018 Onwards Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Relevant CDs, Movies, Documentaries & Other Literature:

1. Value Education website, <http://uhv.ac.in>
2. Story of Stuff, <http://www.storyofstuff.com>
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story

HVPE102-18 Human Values, De-addiction and Traffic Rules Lab
Ability enhancement Compulsory Course (AECC)

One each seminar will be organized on Drug De-addiction and Traffic Rules. Eminent scholar and experts of the subject will be called for the Seminar atleast once during the semester. It will be binding for all the students to attend the seminar.

BSMB201-19 Bacteriology

Unit I Cell organization Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaeobacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes 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 II Bacteriological techniques

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria. Microscopy Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope

Unit III Growth and nutrition Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation Chemical methods of microbial control: disinfectants, types and mode of action. Reproduction in Bacteria Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate

Unit IV Important archaeal and eubacterial groups

Archaeobacteria: General characteristics, phylogenetic overview, genera belonging to Nanoarchaeota (Nanoarchaeum), Crenarchaeota (Sulfolobus, Thermoproteus) and Euryarchaeota [Methanogens (Methanobacterium, Methanocaldococcus), thermophiles (Thermococcus, Pyrococcus, Thermoplasma), and Halophiles (Halobacterium, Halococcus)]
Eubacteria: Morphology, metabolism, ecological significance and economic importance of following groups: Gram Negative and Gram Positive Bacteria

Suggested Readings / Books

- Atlas RM. (1997). Principles of Microbiology. 2nd edition. W.M.T. Brown Publishers.
- Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
- Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
- Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
- Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
- Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
- Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.
- Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
- Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

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B.Sc. (Hons) Microbiology Batch 2020 onwards

BSMB 202-19 Bacteriology (Lab)

1. Preparation of different media: synthetic media BG-11, Complex Media-Nutrient agar, McConkey agar, EMB agar.]
2. Simple staining
3. Negative staining
4. Gram's staining
5. Acid fast staining-permanent slide only.
6. Capsule staining
7. Endospore staining.
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
10. Estimation of CFU count by spread plate method/pour plate method.
11. Motility by hanging drop method.

BSMB 203-19 Fundamentals of Biochemistry

Unit I Chemical foundations of life: Water: unique properties, its interactions in aqueous systems and ionization, water as a reactant. Chemical bonds: ionic, covalent, hydrogen, hydrophobic, vanderwaal interactions and salt bridges.

Carbohydrates: Families of monosaccharides Stereo isomerism of monosaccharides, epimers, mutarotation and anomers, enantiomers. Haworth projection formulae for glucose; Structures of biologically important sugar derivatives. Disaccharides, concept of reducing and non-reducing sugars, Polysaccharides, homo and hetero polysachharides, structural and storage polysaccharides. Carbohydrates as informational molecules.

Unit II Lipids Building blocks of lipids -fatty acids, glycerol, ceramide Storage lipids: triacyl glycerol and waxes; Structural lipids. Phosphoglycerides. Galactolipids, sulpholipids, etherlipids, sphingolipids and sterols Lipid functions: cell signals, cofactors, prostaglandins, pigments. Introduction of lipid micelles, monolayers, bilayers, structure, distribution and role of membrane lipids. Plant steroids, glycolipids (gangliosides and lipopolysaccharides)

Unit III Proteins: Amino acids: Structural features and classification, notation; Physical and optical properties (Stereoisomerism); Chemical properties (acid base properties, titration curve); Uncommon amino acids and their functions, Peptide bond and its properties; Oligopeptides: Structure and functions of naturally occurring glutathione and insulin and synthetic aspartame. Primary, secondary, tertiary and quaternary protein structure, Functions of proteins, Forces holding the polypeptide together. Structure and role of glycoconjugates - proteoglycans, glycoproteins.

Unit IV Nucleic Acids and vitamins Nucleic acids: Structure and properties of purine and pyrimidine bases, nucleosides, nucleotides, nucleic acids. DNA structure – Watson-Crick model of DNA, forms of DNA; Structures of mRNA, tRNA and rRNA; Effect of acid and alkali on DNA. UV absorption by nucleic acids; Other functions of nucleotides - energy source, component of coenzymes and second messengers

Vitamins: Sources, structures, properties and functions of water and fat soluble vitamins. TPP, pyrodoxal phosphate, nicotinamide, flavin nucleotide, coenzyme A and biotin as coenzymes.

Suggested Readings / Books

1. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company,
2. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons
3. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.

BSMB 204-19 Fundamentals of Biochemistry (Lab)

1. Use of pH meter.
2. Preparation of normal and molar solutions
3. Preparation of phosphate and Tris buffers
4. Qualitative test for carbohydrates
5. Identification of reducing vs non reducing sugars
5. Qualitative test for lipids
6. Qualitative and quantitative test for amino acids and proteins
7. Qualitative and quantitative test for nucleic acids
8. Study of protein secondary and tertiary structures with the help of models
9. Separation of amino acids by thin layer chromatography
10. Estimation of vitamin C

BSMB 205-19 Molecular Biology

Unit I Structures of DNA and RNA / Genetic Material DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves. DNA topology - linking number, topoisomerases; Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure, Organelle DNA -- mitochondria and chloroplast DNA.

Unit II Replication of DNA (Prokaryotes and Eukaryotes)

Bidirectional and unidirectional replication, semi- conservative, semi- discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends Various models of DNA replication including rolling circle, D- loop (mitochondrial), Θ (theta) mode of replication and other accessory protein, Mismatch and excision repair

Unit III Transcription in Prokaryotes and Eukaryotes

Transcription: Definition, difference from replication, promoter - concept and strength of promoter RNA Polymerase and the transcription unit Transcription in Eukaryotes: RNA polymerases, general Transcription factors Post-Transcriptional Processing Split genes, concept of introns and exons, RNA splicing, spliceosome machinery, concept of alternative splicing, Polyadenylation and capping, Processing of rRNA, RNA interference: si RNA, miRNA and its significance

Unit IV Translation in Prokaryotes and Eukaryotes

Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides in both prokaryotes and eukaryotes, Fidelity of translation, Inhibitors of protein synthesis in prokaryotes and eukaryote Regulation of gene Expression in Prokaryotes and Eukaryotes Principles of transcriptional regulation, regulation at initiation with examples from lac and trp operons, Sporulation in Bacillus, Yeast mating type switching , Changes in Chromatin Structure - DNA methylation and Histone Acetylation mechanisms.

Suggested Readings/ Books

- Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
- Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
- De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
- Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
- Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
- Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
- Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

BSMB 206-19 Molecular Biology Lab

1. Study of different types of DNA and RNA using micrographs and model / schematic representations
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
3. Isolation of genomic DNA from E. coli
4. Estimation of salmon sperm / calf thymus DNA using colorimeter (diphenylamine reagent) or UV spectrophotometer (A260 measurement)
5. Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer (A260 measurement)
6. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
7. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).

BSMB 207 Microbial Physiology and Metabolism

Unit I: Introduction

Microbial Growth and Effect of Environment on Microbial Growth. Definition and measurement of microbial growth, batch and continuous cultures, generation time and specific growth rate, synchronous growth, diauxic growth curve. Effect of environment (temperature, pH, oxygen and water activity) on microbial growth, extremophiles. Effect of nutrition and energy on microbial growth

Unit II Specialized Cell Structures and Function

Structure of microbial cell surfaces, peptidoglycan and LPS synthesis. Nutrient uptake and Transport: Passive and facilitated diffusion, Primary and secondary active transport, concept of uniport, symport and antiport. Group translocation, Iron uptake. Periplasm, microbial biofilms. Microbial mobility: organs and their functions.

Unit III Carbohydrate Metabolism

Sugar degradation pathways: EMP, ED, Pentose phosphate pathway, phosphoketolase pathway. Aerobic Respiration Concept of aerobic respiration, TCA cycle, glyoxalate cycle, oxidative phosphorylation: components of respiratory chain, comparison of mitochondrial and bacterial ETC, uncouplers and inhibitors. Anaerobic respiration and fermentation: Alcohol fermentation and Pasteur effect, concept of linear and branched fermentation pathways, Lactic Acid Fermentation (homo and heterofermentative pathways), Basics of Yeast Fermentation, Mixed-Acid Fermentations, Propionic and acetic Acid Fermentation. *Metabolism of lactose, galactose, maltose, pectin, cellulose, starch and glycogen by bacteria.*

Unit IV Photosynthesis, Nitrogen Metabolism and Inorganic Metabolism

Characteristics of Autotrophs: Photosynthetic, Cyano and purple bacteria, anoxygenic vs. oxygenic photosynthesis, eria and cyanobacteria Autotrophic CO₂ Fixation and Mechanisms of Photosynthesis, Hydrogen oxidation (definition and reaction), methanogenesis (definition and reaction), Sulfur Bacteria, Iron Bacteria, Methylophils, , Nitrogen Metabolism - an overview, Introduction to biological nitrogen fixation, Ammonia assimilation, Dissimilatory and assimilatory nitrate reduction (Denitrification; nitrate/nitrite and nitrate/ammonia respiration); fermentative nitrate reduction, Nitrifying Bacteria.

Suggested Readings / Books

- Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. PrenticeHall International Inc.
- Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
- Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
- Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
- Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition,McMillan Press.
- Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition.McGraw Hill Higher Education

BSMB 208 Microbial Physiology and Metabolism (Lab)

1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
3. Effect of temperature on growth of *E. coli*
4. Effect of pH on growth of *E. coli*
5. Effect of carbon and nitrogen sources on growth of *E.coli*
6. Effect of salt on growth of *E. coli*
7. Demonstration of alcoholic fermentation

IKG Punjab Technical University
B.Sc. (Hons) Microbiology Batch 2020 onwards

BSMB301/19 VIROLOGY

Course Objectives – This course is designed to impart basic knowledge about viruses including nature, types (bacteriophages, plant and animal viruses), their mode of replication, reproduction and methods for prevention and control of viral infections to undergraduate level students.

Learning outcomes – After the course is finished the students are expected to know and understand about basics of viruses and their importance for bacteria, plants and animals. They are expected to be conversant with modes of replication strategies adopted by different viral pathogens including strategies and methods to mitigate viral pathogens.

UNIT 1 BASIC CONCEPTS AND CLASSIFICATION OF VIRUSES (8 hours)

Discovery and origin of viruses, General properties of viruses, Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses Isolation, purification and cultivation of viruses, Classification and taxonomy of viruses.

UNIT 2 BACTERIOPHAGES (8 hours)

T4 phage- structure, life cycle, genetic map and DNA replication. Lamda temperate phage: Structure, genetic map, lytic and lysogenic cycle, lysogenic repression and phage immunity, Lambda regulon, applications of phages in microbial genetics.

UNIT 3 ANIMAL VIRUSES AND PLANT VIRUS(20 hours)

Life cycle and Replication strategies of different animal viruses namely SARS-CoV-2, Herpes virus, Dengue virus, Poliovirus, Influenza virus, VSV, SV40 and Adeno Virus, Poxviruses, Hepatitis Viruses, Retroviruses. Salient features and replication pattern of Plant virus such as Tobacco Mosaic virus, cauliflower mosaic virus, Rhabdo virus and wound tumor virus

UNIT 4 VIRAL PATHOGENESIS AND ANTI-VIRAL STRATEGIES (9 Hours)

Stages of infection, Salient features of some viral diseases-epidemiology, transmission, infection, symptoms, risk, Host specific and nonspecific defense mechanisms involved in resistance to and recovery from virus infections, Antiviral compounds and their mode of action, Interferon and their mode of action, General principles of viral vaccination

SUGGESTED READINGS/ BOOKS [Kindly mention updated books not beyond 2010 ideally.]

- Dimmock, NJ, Easton, AL, Leppard, KN (2016). Introduction to Modern Virology. 7th edition, Blackwell Publishing Ltd.
- Carter J and Saunders V (2013). Virology: Principles and Applications. John Wiley and Sons. 2nd Edition, John Wiley & Sons
- Wagner EK, Hewlett MJ, Bloom DC, Camerin D (2007). Basic Virology. 3rd edition. Blackwell Publishing.
- Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
- Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
- Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
- Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
- Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

BSMB302/19 VIROLOGY LAB

1. Study of the structure of important animal viruses (rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs
2. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs
3. Study of the structure of important bacterial viruses (ϕ X 174, T4, λ) using electron micrograph.
4. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique
5. Determining the genome characteristic of viruses (Genome size, GC content, number of genes and proteins)

BSMB303/19 MICROBIAL GENETICS

UNIT 1 GENOME ORGANIZATION AND MUTATIONS

Genome organization: *E. coli*, *Saccharomyces cerevisiae*, *Neurospora crassa*. Mutations and mutagenesis: Definition and types of Mutations: substitutions, frameshift, inversion, insertion, duplication, deletion. Silent, conditional and lethal mutations. Mutagens: Chemical & physical; loss and gain of function mutants; Uses of mutations, Reversion and suppression: True revertants; Intra- and inter-genic suppression; Mutator genes; Ames test.

UNIT 2 PLASMIDS

Types of plasmids (F, R, colicinogenic, Ti, linear, 2 μ), Replication and partitioning of plasmids, plasmid incompatibility, Host range, plasmid amplification, Plasmid copy number and control, curing of plasmids

UNIT 3 MECHANISMS OF GENETIC EXCHANGE

Transformation - Discovery, mechanism of natural competence, Conjugation - Discovery, mechanism, Hfr and F' strains, gene mapping by interrupted mating and time of entry, Transduction - Generalized & specialized, LFT & HFT lysates, Mapping by recombination and co-transduction of markers

UNIT 4 PHAGE GENETICS AND TRANSPOSABLE ELEMENTS

Basic genetics of T4 phage, lytic and lysogenic switching of phage lambda, Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon, Eukaryotic transposable elements - Yeast (Ty retrotransposon) & Drosophila (P elements), Maize (Ac/Ds), Uses of transposons.

Suggested Readings/ Books

- Concepts of Genetics by W.S. Klug, M.R. Cummings, C. Spencer and M. Palladino. 12th edition. Pearson Education, USA. 2018.
- Lewin's Essential Genes by J. Krebs, E. Goldstein and S. Kilpatrick. 3rd edition. Jones and Bartlett Learning, USA. 2013.
- Genomes by Terence A Brown. 2nd edition. Oxford: Wiley-Liss; 2002.
- Genetics: A Conceptual Approach by B.A. Pierce. 4th edition. Macmillan Higher Education Learning, UK. 2011.
- Molecular Biology of the Gene by J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levine and R. Losick. 7th edition. Pearson Education, USA. 2017.
- iGenetics- A Molecular Approach by P.J. Russell. 3rd edition. Benjamin Cummings, USA. 2009.
- Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
- Microbial Genetics by S.R. Maloy, J.E. Cronan and D. Friefelder. 2nd edition. Jones and Barlett, USA. 2004
- Principles of Genetics by E.J. Gardner, M.J. Simmons and D.P. Snustad. 8th edition. John Wiley & Sons Ltd, UK. 2008.
- Molecular Genetics of Bacteria by L. Snyder, J.E. Peters, T.M. Henkin, W. Champness. 4th edition. ASM Press, USA. 2015.

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BSMB304/19 MICROBIAL GENETICS LAB

1. Preparation of bacterial master and replica plates
2. Effect of chemical (HNO₂) and physical (UV) mutagens on bacterial cells
3. Survival curve of bacteria after exposure to ultraviolet (UV) light
4. Plasmid isolation from E.coli
5. Study of different plasmid DNA conformations by Agarose gel electrophoresis.
6. Demonstration of Bacterial Conjugation
7. Demonstration of bacterial transformation
8. Demonstration of AMES test

BSMB 305 MICROBES IN ENVIRONMENT

UNIT 1 MICROORGANISMS AND THEIR HABITATS- I

Structure and function of ecosystems, Terrestrial Environment: Soil profile and soil microflora, Aquatic Environment: Microflora of fresh water and marine habitats, Atmosphere: Aeromicroflora and dispersal of microbes.

UNIT 2 MICROORGANISMS AND THEIR HABITATS- II

Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body, Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

UNIT 3 MICROBIAL INTERACTIONS

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non symbiotic interactions. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

UNIT 4 WASTE MANAGEMENT

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment

SUGGESTED READINGS/ BOOKS

- Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
- Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
- Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
- Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York
- Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
- Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
- Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
- Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
- Martin A. (1977). An Introduction to Soil Microbiology. 2nd edition. John Wiley & Sons Inc. New York & London.
- Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
- Subba Rao NS. (1999). Soil Microbiology. 4th edition. Oxford & IBH Publishing Co. New Delhi.
- Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

BSMB 306 MICROBES IN ENVIRONMENT LAB

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C).
3. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
4. Assessment of microbiological quality of water.
5. Determination of BOD of wastewater sample.
6. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
7. Isolation of Rhizobium from root nodules

BSMB 307/19 MICROBIOLOGICAL ANALYSIS IN AIR AND WATER

UNIT 1 AEROMICROBIOLOGY, AIR SAMPLE COLLECTION AND ANALYSIS

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens. Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics

UNIT 2 WATER MICROBIOLOGY AND MICROBIOLOGICAL ANALYSIS OF WATER

Water borne pathogens, water borne diseases. Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Suggested Reading

- Microbiological Examination Methods of Food and Water A Laboratory Manual, CRC Press
- da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012)
- Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
- Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
- Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press

BSMB 308/19 BIOSTATISTICS

UNIT 1 INTRODUCTION TO STATISTICS

Data types and presentation, Populations and samples, Measures of central tendency; means, median and mode, quantiles Measures of dispersion; Range, variance, standard deviation, skewness, kurtosis, Shannon-Weaver index; Elementary Probability and basic laws; Discrete and Continuous Random variable.

UNIT 2 STATISTICS HYPOTHESIS TESTING

Normal distribution, normal curve and normal deviate, statistical hypothesis testing and probability, type I and type II errors, statistical power, confidence limits binomial distribution and Poisson distribution.

UNIT 3 COMMONLY USED STATISTICAL TEST

One sample hypothesis testing (t-test), two tailed and one tailed tests. two sample t-test, Variance ratio test, Non-parametric tests, Mann-Whitney test, paired sample t-test, Wilcoxon, paired sample test, Analysis of variance test. Chi-square test for testing goodness of fit.

UNIT 4 CORRELATION AND REGRESSION

Simple linear correlation, covariance, coefficient of correlation, coefficient of determination, hypotheses about the correlation coefficient, Spearman's rank correlation, Simple linear regression, regression coefficient and intercept.

Suggested Readings/ Books

- J. H. Zar: Biostatistical Analysis, Pearson publication; 2014
- A. B. Khanal: Mahajan's Methods in Biostatistics for Medical Students and Research Workers, Jaypee publishers; 2016
- Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.
- W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004.