BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology
(CBCS- 2018 COURSE)

Semester: I

PG MB 101: BIOCHEMISTRY

Total Credits: 4 **Total Lectures:60**

UNITI INTRODUCTORY BIOCHEMISTRY 02

1. The scope of Biochemistry
   - What is Biochemistry?
   - Goals of Biochemistry.
   - The roots of Biochemistry.
   - Biochemistry as a discipline and an interdisciplinary science.
   - Biochemistry as a chemical science.
   - Biochemistry as a biological science.
   - New tools in Biological revolution
   - The uses of Biochemistry.

UNITII BASIC CONCEPTS IN BIOCHEMISTRY 04

1. Common organic compounds found in living system
   - Common functional groups in biochemistry.OH, CHO, C = 0, NH2, C – NH2, SH, ester, ethers, methyl, ethyl, phospho, guanidio, imidazole etc).
   - Common ring structures in biochemistry.
   - Isomerism.
   - Isotopes.
   - Energetics.
   - Redox systems.
   - High energy compounds.

UNITIII WATER 02

1. Structure and properties.
   - Water as a solvent.
   - Ionization.
   - Ionic equilibrium.

UNIT IV STRUCTURAL FEATURES AND CHEMISTRY OF MACROMOLECULES 10

1. Nucleic acids:
   - Tautomeric forms of bases and their implication in pairing of bases.
   - Structure of polynucleotides, DNA structure, DNA and RNA (t -RNA, r- RNA, m- RNA etc).
   - Structure of DNA double helix.
   - R and L handed forms.

- A, B, C and Z forms of DNA.
- Denaturation and Renaturation of DNA and Tm value.

2. **Proteins** **12**
   - Amino acids.
   - Peptides – Prepeptide linkage, partial double bond nature of peptide linkage.
   - Proteins – structural classification of Proteins, primary structure, secondary structure, tertiary structure, Quarternary structure.
   - Determination of primary structure of polypeptide (N terminal determination, C terminal determination, Partial hydrolysis, Overlapping sequence etc.) α helix of polypeptide.
   - Structure and functions of globular proteins.
   - Immunological techniques to investigate proteins.
   - Artificial synthesis of polypeptides.

3 **Membrane transport** **10**
   - Overview of membrane transport.
   - ATP powered pumps and intracellular ionic environment.
   - Non gated Ion channels and the resting membrane potential.
   - Co-transport – symport, antiport.
   - Neurotransmitters.
   - ATP driven active transport system for Sodium and Potassium ions.
   - Proton gradient in *Halobacteria.*
   - Transport of antibiotics that increase the ionic permeability of membranes.

4. Carbohydrates **08**
   - L forms and D forms of sugar.
   - Reducing and non reducing sugars.
   - Aldoses / ketoses.
   - Alpha and Beta, ring forms of sugars.
   - Glycosidic linkages.
   - Sugarderivatives – sugar alcohol, amino sugars, dextro sugars, sugaracids
   - Polysaccharides (starch, glycogen, cellulose)

5. Lipids **12**
   - Fatty acids – Types and nomenclature.
   - Saturated and unsaturated fatty acids,
   - Structure and function of Triglycerides, Phospholipids, Sphingolipids.
   - Structure and function of steroids, terpenes, prostaglandins.

Literature Cited

1. Doelle, H.W. (1975) Bacterial Metabolism 2nd Edition Academic Press, Inc. N.Y.
2. Jayraman – Laboratory manual in Biochemistry, New Age International publishers, New Delhi.
3. Lehninger A.L. (1984): Principles of Biochemistry, 1st Indian Edition, LBS publishers and distributors Pvt. Ltd. New Delhi.

4. LehningerA.L. (2000) Principles of Biochemistry II Edition by D.KL. Nelson and M.M. Cox McmillanWorth Pub. Inc. N.Y.
5. Mehler H.R. (1968) Basic biological chemistry, Harper and Row publisher, Inc. New York.
6. Murray R..K., Harper's Biochemistry, Appleton and Lange Stanford, 25th Edition.
7. D. Plummer, J. Wiley & Sons Introduction to practrical Biochemistry by – W.H. Freeman & Company publishers, SanFrancisco
8. Stryer, W.H. Freeman (1992) Biochemistry IV Edition and Co. N.Y.
9. Tood, H.S. Mason, J.T.V. Burger (1966). Text book of biochemistry, 4th Edition – west E.S.W.RMacMillan Company, New York
10. West E.S., W.R. Todd, H.S. Mason. J.T.V. Burgger (1966) Text book of biochemistry, 4th Edition, MacMillan, New York.
11. White A., P. Handler. E.L. Smith (1973) Principles of Biochemistry, 5th Edition.
12. Wilson K. and J. Walker,(1999) Cambridge University Press. Principles and techniques at Practical biochemistry

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BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology
(CBCS- 2018 COURSE)

Semester : I

PG MB 102: IMMUNOLOGY

Total Credits: 04 **Total Lectures:60**

UNITIIMMUNOGLOBULINS **10**

1. Fine Structure
2. Classes & biological activities
3. Organization & expression of immunoglobulin genes
    - Genetic model compatible with Ig structure
    - Multigene organization of Ig Genes.
    - Variable region gene rearrangements
    - Mechanism of Variable region DNA rearrangements
    - Generation of Antibody diversity
    - Expression of Ig Genes
    - Regulation of Ig - Gene transcription.
    - Antibody genes and antibody engineering

UNITIIMAJOR HISTOCOMPATIBILITY COMPLEX **07**

1. General Organization and Inheritance of the MHC
2. MHC molecules and Genes
3. Detailed Genomic Map of MHC genes
4. Cellular Distribution of MHC molecules
5. Regulation of MHC Expression.
6. MHC and Immune Responsiveness
7. MHC and Disease susceptibility

UNITIIIIMMUNE EFFECTOR MECHANISMS **15**

1. Cytokines – properties, receptors, antagonists, Cytokine secretion, related diseases, Therapeutic uses.
2. Complement system - Functions, Components, activation, Regulation, Biological consequences, Deficiencies.
3. Leukocyte Migration & Inflammation- Lymphocyte re-circulation, Cell Adhesion molecules, Neutrophils Extravasation, Lymphocyte Extravasation, Mediators of Inflammation, The inflammatory process, Anti inflammatory agents.
4. Hypersensitive Reactions - Type I, TypeII, Type III and Type IV hypersensitivity reactions.

UNIT IV IMMUNODEFICIENIES, AUTOIMMUNITY & AIDS 10

1. Primary Immunodeficiencies
    - X- linked Agammaglobunaemia
    - Common Variable Immuno Deficiency (CVID)
    - Di George Syndrome
    - Wiskott Aldrich Syndrome

2. Acquired or Secondary Immunodeficiencies.
    - Down's syndrome
    - AIDS
    - Hodgkins disease
3. Organ Specific autoimmune diseases
    - Graves Disease
    - Myasthenia gravis
    - Insulin Dependent Diabetes
4. Systemic Autoimmune diseases.
    - Goodpasteure's Syndrome,
    - Rheumatoid Arthritis,
    - Systemic Lupus Erythematosus
5. Animal models for Autoimmune Disease
6. Proposed Mechanism for Induction of Autoimmunity
7. Treatment of Autoimmune Diseases.

UNITVTRANSPLANTATION IMMUNOLOGY 08

1.Immunologic Basics of Graft Rejection.
2.Clinical manifestation of Graft rejection
3.General Immunosuppressive Therapy
4.Specific Immunosuppressive Therapy
5.Clinical Transplantation

UNITVICANCER& THE IMMUNE SYSTEM 10

1. Cancer origin & Terminology
2. Malignant transformation of cells
3. Oncogenes & cancer induction.
4. Tumors of the Immune system
5. Tumor antigens.
6. Immune response to tumors.
7. Tumor Evasion of the Immune system
8. Cancer Immunotherapy.

Literature Cited

1. Cruse J and R. Lewis (2004) Atlas of Immunology 2nd Edn. CRC Press.
2. David Male, Jonathan Brostoff, David B Roth, Ivan Roitt.(2006).Immunology 7th edition.
3. Goldsdby R.A. Kindt T.S. and B.A. Osborne Kuby (2000) Immunology Fourth Edition W.H. Freeman & Co New York.
4. Reed R; Holmes D; Weyers J and A Jones (1998) Practical skills in Biomolecular Sciences Adison Wesley Longman Ltd.

5. Tizard; I.R. (1995) Immunology an Introduction 4th Edn. Saunders College Publishing. Harcourt Brace College Publishers.

BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology
(CBCS- 2018 COURSE)

Semester –I

PG MB 103– GENETICS AND MOLECULAR BIOLOGY

Total Credits: 04 **Total Lectures:60**

UNITISTRUCTURE OF EUKARYOTIC CHROMOSOME 15

1. Genome complexity.
2. Chemical composition.
3. Packaging the giant DNA molecules into chromosome
4. Euchromatin and heterochromatin.
5. Repetitive DNA and sequence organization.
6. Replication of Eukaryotic chromosome.
7. Comparison with structure and replication of prokaryotic chromosome.
8. Effect of different antibiotics on chromosome structure and replication.
   - Antibiotics that affect replication and DNA structure.
   - Antibiotics that block precursor synthesis.
   - Antibiotics that block polymerization of Nucleotides.
   - Antibiotics that affect DNA structure.
   - Antibiotics that affect Gyrase.

UNITII GENE EXPRESSION 20

1. Evolution of the one gene one polypeptide concept.
2. Genetic control of metabolism.
   - **Transcription.**
     a. The transcription process. RNA synthesis, Classes of RNA and the Genes that code for them.
     b. Transcription of protein coding genes. Prokaryotes, Eukaryotes, mRNA molecules.
     c. Transcription of other genes, Ribosomal RNA and Ribosomes, Transfer RNA.
   - **Protein structure.**
     a. Chemical structure of proteins.
     b. Molecular structure of proteins.
   - **Nature of the Genetic code.**
     a. Genetic code is a triplet code.
     b. Deciphering the genetic code.
     c. Nature and characteristic of the genetic code.
   - **Translation of the genetic message.**
     a. Aminoacyl t-RNA molecules.
     b. Initiation of translation.
     c. Elongation of the polypeptide chain.

d. Termination of Translation.

- **Protein sorting in the cell**.
    a. Proteins distributed by the endoplasmic reticulum.
    b. Proteins transported into mitochondria and chloroplast.
    c. Proteins transported into the nucleus.

UNITIIIREGULATION OF GENE EXPRESSION 08

1. **Positive regulation**.
    - *E. coli*maltose operons.
    - The *tol* operons.
2. **Feedback inhibition**.
    - Isoleucine – Valine operon.
    - Histidine operon.
    - Leucine operon.
    - Phenylalanine operon.
    - Threonine operon.

UNITIVGENETIC ENGINEERING 17

1. **Basic techniques**.
    - Agarose gel electrophoresis.
    - Nucleic acid blotting.
    - Transformation of *E. coli*.
    - The polymerase chain reaction (PCR)
2. **Cutting and joining DNA molecules.**
    - Cutting DNA molecules.
    - Joining DNA molecules.
3. **Vectors used for cloning**
    - Plasmids.
    - Phages.
    - Vectors for cloning large fragments of DNA.
    - Specialist purpose vectors.
4. **Cloning strategies**.
    - Cloning genomic DNA.
    - c -DNA cloning.
    - Screening strategies.
    - Difference cloning.
5. **Applications of recombinant DNA technology.**
    - Nucleic acid sequences as diagnostic tool.
    - New drugs and new therapies for genetic diseases.
    - Combating infectious diseases.
    - Protein Engineering.
    - Metabolic Engineering.
    - Transgenic technology.
        a. Transgenic plants.
        b. Transgenic animals.

Literature cited

1. Alberts. B.; Johnson. A, Lewis J. Raff, M. Roberts. K. and P. Walter (2002) Molecular Biology of the cell 4th Edition. Garland Science, Taylor & Francis Group.
2. Clayton. J and C. Dennis. (2003) 50 years of DNA. Nature Publishing group.
3. Elliott. W.H. and D.C. Elliot (2001) Biochemistry and molecular Biology. 2nd Edn. Oxford University Press.
4. Gardner E.J., Simmons, M.J and D.P. Snustad. (1991) Principles of Genetics. 8th Edition. John Willey & Sons. Inc.
5. Hartl. D.L. and E.W. Jones. (1999) Essential Genetics. Second Edition. Jones and Bartlett Publisher.
6. Kleinsmith L.J. and V.M. Kish. (1995). Principles of Cell and molecular Biology 2nd Edn. Haper Collins. College Publishers.
7. Lewin B. (2004) Genes VIII – International Edition. Pearson. Prentice Hall. Pearson Education International.
8. Lewin. B. (2000) Genes VII. Oxford University Press.
9. Pierce.B.A, (2005) Genetics A Conceptual Approach.2nd Edition.W.H.Freeman and Company,New York
10. Primrose. S.B. and R.M. Twyman and R.W. Old (2003). Principles of Gene Manipulation. 6th Edn. Blackwell Science.
11. Russel. P. (1998) Genetics Fifth edition. Addison. Wesley Longman Inc.
12. Sambrook. J and D.W. Russel. (2001) Molecular cloning. A Laboratory Manual. 3rd Edn. Vol. 1,2,3. Cold Spring Harbor laboratory Press.
13. Sheeler P. and Bianchi D.E. (1987) Cell and Molecular Biology 3rd Edn. John Wiley and Sons. Inc.
14. Snyder. L. and W. Champress. (1997) Molecular Genetics of Bacteria. ASM Press. Washington. D.C.
15. Watson J.D. Baker T.A., Bell S.P. Gann A, Levine M. and R. Losick. (2004) Molecular Biology of the Gene. 5th Edn. Low Price edition. Pearson Education.
16. Winter P.C., G.I. Hickey and H.L. Fletcher (2000) Instant notes in Genetics. Viva Books Pvt. Ltd.

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BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology
(CBCS- 2018 COURSE)

Semester –I

PG MB-104 MICROBIAL ECOLOGY

Total Credits: 04 **Total Lectures:60**

UNIT IINTRODUCTION TO BASIC CONCEPTS OF ECOLOGY 02

UNITII MICROBIAL ECOLOGY 15

1. Historical Developments
2. Microbial evolution and Biodiversity
3. Types of Biodiversity
4. Biodiversity concept -
    - Alpha and Beta biodiversity.
    - Steps to preserve biodiversity.
5. Genetic basis for evolution and Ribosomal RNA analysis for tracing microbial evolution
6. Biodiversity conservation and Species conservation
7. Microbial communities and ecosystem
    - Development of microbial communities
    - Succession within microbial communities
    - Diversity and stability of microbial communities
    - Risk of introducing genetically modified microorganisms
8. Quantitative ecology
    - Sample collection
    - Sample processing
    - Detection of microbial populations
    - Determination of microbial numbers
    - Measurement of microbial metabolisms

UNIT III MICROBIAL LIFE IN EXTREME ENVIRONMENT 12

1. Abiotic limitations to microbial growth
2. Effects of environmental determinants
    - Extreme pH.
    - Temperature.
    - Pressure.
    - Salt and solute.
    - Heavy metals.

- Radiations.
- Water activity
- Movement
- Magnetic poles
- Redox potential
- Organic and inorganic compounds.
- Examples of extreme environments
  a) Hot springs.
  b) Acid springs and Lakes.
  c) Sea and salt lakes.
  d) Antarctica and ocean bottom.

UNIT IV MICROORGANISMS IN MINERAL AND ENERGY RECOVERY 10

1. Microbial assimilation of metals
2. Bioleaching of metals-Gold, Uranium, Copper.
3. Metal and metallic transformation- Mercury, Arsenic, Lead.
4. Recovery of petroleum
5. Production of fuels – ethanol, methane, hydrogen

UNIT V BIODETERIORATION 03

1. Concept of biodeterioration.
2. Biodeterioration of –
   - Wood.
   - Stone work.
   - Pharmaceutical products.
   - Metal Corrosion.
   - Rubber.
   - Plastic.
   - Concrete
   - Paper & Textile.
   - Paints.
   - Computer diskette and cassette films.
   - Lubricants and Adhesives, cosmetics.
3. Control of biodeterioration.

UNIT VIBIOFILMS 02

1. Population within biofilms
2. Fouling Biofilms
3. Control of Biofilms

UNIT VIIPLANT PATHOLOGY 08

1. Pathogenesis, Entry through various routes.
2. Enzymes and toxins in plant diseases – different enzymes and toxins and their role in diseases.
3. How plants defend themselves against infections, different modes of defense.
4. Effect of environmental factors and nutrition on disease development.

5. Management of plant diseases.-
    - Microbial amensalism and parasitism to control microbial pathogens-antifungal amensalism and antibacterial amensalism
    - Bacterial biopesticides
    - Fungal biopesticides
    - Viral biopesticides

UNITVIII CASE STUDIES 08

Literature Cited

1. Arora. M.G. and M. Singh (1994) Industrial Chemistry Vol. I & II. Anmol Publications Pvt. Ltd.
2. Asthana D.K. and M. Asthana (2003) Environment Problems & Solutions. S. Chand and Co. Ltd. New Delhi.
3. Barnum. S.R. (1998) Biotechnology: An introduction. Wadsworth Publishing company. An International Thomson Publishing company.
4. Bathra Atlas (2007) Microbial Ecology Fundamentals and Application4th edition , Pearson Education Publication
5. De. A.K. (1994) Environmental Chemistry, New Age International (P) Limited, Publishers.
6. Gray. N.F. (2000) Water Technology. An Introduction for Environmental Scientists and Engineers. Viva Books Pvt. Ltd. New Delhi.
7. Jadhav H.V. (1992) Elements of Environmental Chemistry. Himalaya Publishing House.
8. Kormondy E J. (2007)Concepts in Ecology,4th edition, Pearson Education Publication
9. MooreJ.W. and E.A. Moore (1976) Environmental Chemistry Academic Press, New York.
10. Mukherjee N. and T. Ghosh (1995) Agricultural Microbiology. First Edition. Kalyani Publishers, New Delhi, Ludhiana, Hyderabad, Madras, Calcutta Cuttack.
11. Rao. C.S. (1991) Environmental pollution control Engineering Wiley Eastern Limited New Delhi. Bangalore, Bombay, Calculta, Guwahati, Hyderabad, LukknowMadra& Pune.
12. Rittman B.E. and P.L. McGarty. (2001) Environmental Biotechnology. Principles & Applications. McGraw Hill International Editions. Biological Sciences Series.
13. Santra. S.C. (2001_ Environmental Science, New Central Book Agency (P) Ltd.
14. Sharma B.K. and H. Kaur (1994). Water pollution Goel Publishing House Meerut.
15. Subbarao N.S., Soil Microbiology Fourth Edition of Soil Micro-organisms and plant growth. Published by RajuPrimlani for oxford and JBH Publishing. Co. Pvt. New Delhi.
16. Tripathi A.K. (1993) Understanding Environmental Disruption. Volume-I & II. Ashish Publishing House, New Delhi.
17. Verma, P.S and V.K. Agarwal (1996) Environmental Biology (Principles of Ecology) S. Chand & Co. New Delhi.

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M.Sc. – Microbiology
(CBCS- 2018 COURSE)

SEMESTER-I

PG MB 105 ENVIRONMENTAL MICROBIOLOGY

Total Credits: 04 **Total Lectures:60**

UNIT I AEROMICROBIOLOGY 06

1. Nature of Bioaerosols
2. Sampling of bioaerosols
3. Bioaerosol control

- Extramural Aeromicrobiology
- Intramural Aeromicrobiology
- General Pathological effects of air pollution.
- Biosafety in laboratory

UNIT II WASTE WATER MICROBIOLOGY (DOMESTIC AND INDUSTRIAL) 15

1. **Waste water types.**
   - Characteristics.
   - Nature of pollutants and their effects
   - Microbial pollution and its effects.
2. **Treatment.**
   - Principles of waste water treatment.
   - Disposal of waste water
   - Aerobic processes
     a. Activated sludge process.
     b. Fixed film systems.
     c. High rate filters.
     d. Trickling filters
     e. Rotating biological contactors.
     f. Fluidized bed reactors.
     g. Oxidation ditch.
     h. Aerated lagoons.
   - Anaerobic digestion
     a. Anaerobic lagoons and covered anaerobic lagoons.
   - Biosorption – N and P removal.
   - Biofilms and kinetics
     a. Root zone process.
     b. Reverse osmosis.
     c. Waste water disposal by dilution.
   - Difficulties encountered in operation of different methods of waste treatment.

- Economics of waste treatment and feasibility.

UNITIII BIOREMEDIATION 12

1. Bioremediation of Metals
   - Metal toxicity effect on microbes
   - Mechanisms of microbial resistance to metals, metal -microbe interactions
   - Methods to detect metal – microbe interactions
   - Microbial remediation of metal contaminated soils
   - Microbial remediation of metal contaminated aquatic systems
2. Bioremediation of petroleum
3. Bioremediation of waste gases

UNITIVBIODEGRADATION OF XENOBIOTIC AND INORGANIC POLLUTANTS: 14

1. Recalcitrant organic compounds and their presence in natural ecosystem
2. Concept and Consequence of biomagnifications.
3. Biomagnification of hydrocarbons and pesticides.
4. Process of Biodegradation
5. Relationship between Contaminant Structure, Toxicity and biodegradability
6. Environmental factors affecting biodegradability
7. Biodegradation of recalcitrant xenobiotic and toxic compounds
8. Recalcitrant Halocarbons
9. Recalcitrant Nitro aromatic compounds
10. Polychlorinated Biphenyl's
11. Radionuclide
12. Pesticides

UNITVENVIRONMENTAL LAWS 05

1. Introduction
2. Environmental legislation in India
3. Legal aspects of waste treatment and disposal.
4. Notification relating to hazardous microorganisms and genetically modified organisms.
5. Rules for management of Bio medical wastes

UNITVI CASE STUDIES 08

Literature Cited

1. Arora. M.G. and M. Singh (1994) Industrial Chemistry Vol. I & II. Anmol Publications Pvt. Ltd.
2. Asthana D.K. and M. Asthana (2003) Environment Problems & Solutions. S. Chand and Co. Ltd. New Delhi..
3. Bathra Atlas (2007) Microbial Ecology Fundamentals and Application4th edition, Pearson Education Publication.
4. Agarwal A K , Q A Shammi, Purohit S S,(2007), Environmental Science – A New Approach, AgrabiosJodhapur.(India)

5. De. A.K. (1994) Environmental Chemistry, New Age International (P) Limited, Publishers.
6. Gray. N.F. (2000) Water Technology. An Introduction for Environmental Scientists and Engineers. Viva Books Pvt. Ltd. New Delhi.
7. Jadhav H.V. (1992) Elements of Environmental Chemistry. Himalaya 9
8. Kormondy H.J(2007) Concepts of Ecology .fourth Edn .Pearson, Prentice Hall
9. Kumar A.(2005) Microbial pollution, APH Publishing house, New Delhi.
10. Katyal. T & M. Satake (1991) Environmental Pollution. Anmol Publishers Pvt. Ltd.
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13. Mukherjee N. and T. Ghosh (1995) Agricultural Microbiology. First Edition. Kalyani Publishers, New Delhi, Ludhiana, Hyderabad, Madras, Calcutta Cuttack.
14. Ranade D.R. and R.V. Gadre (1988) Microbiological aspects of anaerobic digestion. Laboratory Manual. Maharashtra association for cultivation of sciences
15. Rao. C.S. (1991) Environmental pollution control Engineering Wiley Eastern Limited New Delhi. Bangalore, Bombay, Calculta, Guwahati, Hyderabad, LukknowMadra& Pune..
16. S. C. Santra(2001) Environmental Science, New Central Book Agency, Calcutta.
17. Sharma B.K. and H. Kaur (1994). Water pollution Goel Publishing House Meerut..
18. Tripathi A.K. (1993) Understanding Environmental Disruption. Volume-I & II. Ashish Publishing House, New Delhi.
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20. Verma, P.S and V.K. Agarwal (1996) Environmental Biology (Principles of Ecology) S. Chand & Co. New Delhi.

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M.Sc. Microbiology
(CBCS- 2018 COURSE)

SEMESTER -I

PGMB 111: Practical course-1

Total Credits: 02 **Total Lectures:120**

UNIT IINSTRUMENTATION & BIOCHEMISTRY **2P**

1. Study of different instruments in the laboratory.
   - Laminar airflow, Microfuge, UV. Spectrophotometer, Incubator shaker, Cooling incubator, Deepfreeze, colorimeter, pH meter, lyophilizer (visit).
   - Laboratory Safety.
2. Preparation of buffers and molar solutions. **2**P
3. Estimation of protein by Lowry's / Biuret method. **2P**
4. Separation & identification of amino acids, carbohydrates by TLC. **2P**
5. Estimation of reducing sugars by DNSA. **2P**
6. Estimation of lipids / fats **3P**
7. Beer Lambert's law. **1P**

UNIT II IMMUNOLOGY

1. **Blood transfusion related techniques.** **3P**
   - Blood grouping.
   - Cross matching.
   - Visit to blood bank.

2. **Study of Immunological reactions.** **5P**
   - Agglutination reactions.
   - Haemagglutionation Inhibition Test
   - Immunodiffusion
   - Demonstration / visit.
     a) RIA, ELISA,
     b) Study of vaccination schedule.

22P

Literature Cited

1. 1Alberts. B.; Johnson. A, Lewis J. Raff, M. Roberts. K. and P. Walter (2002) Molecular Biology of the cell 4th Edition. Garland Science, Taylor & Francis Group.
2. Benjamin Cunnings publishing Co. Inc. 2nd Edition
3. Boyer. R. (2000) Modern Experimental Biochemistry. 3rd Edition. Pearson Education Asia.
4. Cruse J and R. Lewis (2004) Atlas of Immunology 2ndEdn. CRC Press
5. Elliott. W.H. and D.C. Elliot (2001) Biochemistry and molecular Biology. 2ndEdn. Oxford University Press.
6. Hand book of experimental immunology Vol. I by PM. Weinor (editor) 1978. Black Well scientific publications.
7. Jayraman – Laboratory manual in Biochemistry, New Age International. Publishers, New Delhi
8. Mathews C.K. and K.E. Van Holde (1996) Biochemistry. The Benjamin Cunnings publishing Co. Inc. 2nd Edition
9. Plummer D.T, (1992)An introduction to Practical Biochemistry Tata cGraw Hill Publisher,New Delhi
10. .Reed, R; Homes, D; Weyers, J. and A. Jones. Practical skills in Biomelecular Sciences. Addison Wesley Longman Limited.

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M.Sc. Microbiology
(CBCS- 2018 COURSE)

SEMESTER I

PGMB 112: Practical course-2

Total Credits: 02 **Total Lectures:120**

1. Cultivation of Extremophiles.(any two) **10P**

- Acidophiles.
- Alkalophiles.
- Halophiles.
- Psychrophiles.
- Thermophiles.

2. Systematic study of the extremophile isolates using 'Bergey's Manual of Systematic Bacteriology'. **6P**

3. Study of Microbial diversity **2P**

4. Sewage decomposition by aerobic and anaerobic microorganisms. **1P**

5. Determination of BOD and COD of a given sample.**2 P**

6.Determination of TS, TSS and MLSS.**1 P**

22P

Literature Cited

1. Bathra Atlas (2007) Microbial Ecology Fundamentals and Application4th edition, Pearson Education Publication
2. Kormondy H.J(2007) Concepts of Ecology .fourth Edn .Pearson, Prentice
3. Maier R M , I L Pepler, C P Gerba (2000) Environmental Microbiology,
4. Krieg, M. R. and J. G. Holt (Editors) (1984) Bergey's Manual of Systematic Bacteriology. Vol I Williams and Wilkins, Baltimore, London, Tokyo
5. Sharma B.K. and H. Kaur (1994). Water pollution Goel Publishing House Meerut.
6. Sneath, P. H. A. Mair: N. S. Sharpe: M. E. and J. G. Holt (Eds) (1986). Bergey'sMannual of Systematic Bacteriology Vol. II Williams and Wilkins, Baltimore, London, Tokyo.
7. Staley, J. T. Bryant: M. P. Penning: N and J. G. Holt (Eds) (1989) Bergey'sMannual of

Systematic Bacteriology Vol. III Williams and Wilkins, Baltimore, London, Tokyo,

8. Skinner,(1987)Bacterial Systematics Academic Press.
9. Cappucino& Sherman (2004) Microbiology a laboratory mannual 6th Edn. Pearson Education, New Delhi.
10. Tripathi A.K. (1993) Understanding Environmental Disruption. Volume-I & II. Ashish Publishing House, New Delhi.
11. Trivedi R K (1998) Advances in Wastewater Treatment Technologie vol.1, Global Science, Aljgarh
12. Willi ams, S. T. Sharpe: M. E. and J. G. Holt (Eds) (1989) Bergey'sMannual of Systematic Bacteriology. Vol. IV Williams and Wilkins, Baltimore, London, Tokyo.

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BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology (CBCS 2018 COURSE)

Semester –II

PG MB 201– FERMENTOR DESIGN AND MICROBIAL BIOTECHNOLOGY

Total Credits: 04 **Total Lectures:60**

UNIT I FERMENTOR DESIGN 15

1.Design of a Fermentor
2.Basic functions of a fermentor
3.Aseptic operation and containment
4.Body construction
5.Parts of the fermentor and their functions: Impellors, Baffles, Sparger.
6.Achievement and maintenance of aseptic conditions: - Sterilization of fermentor and its parts.
7.Different methods of sterilization.
8.Valves and steam traps: Role in maintaining aseptic conditions.
9.Alterations in the fermentor design for 'Animal cell culture' and 'Plant cell culture'

UNIT II OTHER DESIGNS OF A FERMENTOR 05

1. The Waldfhoff-type fermentor.
2.Acitators and cavitators.
3.The tower fermentors.
4.Cylindro conical vessels.
5.Airlift fermentors.
6.The deep jet fermentor.
7.The cyclone column
8.The packed tower.
9.Rotating-disc fermentor.

UNITIII AERATION AND AGITATION 10

1. The oxygen requirements of industrial fermentations
2. Oxygen supply.
3.Determination of K_La value.
4.Fluid Rheology
5.Factors affecting K_La value in fermentation vessels.
6.Scale-up and scale-down.

UNIT IV MICROBIAL BIOTECHNOLOGY. 30

1. **Commercial production of**
    - Amino acids
    - Polysaccharides.
    - Antibiotics
    - Solvents
    - Enzymes
    - Steroids
    - Nucleotides
    - SCP
    - Organic acids
    - Vitamins

Literature cited

1. Casida. L.E. (2003) reprint Industrial Microbiology Publ: New Age International (p) Ltd. New Delhi.
2. Grace E.S. (1997) Biotechnology unzipped. Promises and Realties Joseph. Henry Press Washington D.C.
3. Kumar. H.D. (1993) Molecular Biology and Biotechnology 2nd revised edition Vikas Publishing house Pvt. Ltd.
4. Mukhopadhyay. S.N. (2001) Process Biotechnology Fundamentals viva Books Pvt. Ltd.
5. Patel. A.H. (2003 reprint) Industrial Microbiology Publ: Macmillan. India Ltd. New Delhi.
6. Peppler. H.J. and D. Perlman (1979) Microbial Technology Vol. I & II Academic Press Inc.
7. Prescott. S.C. and C.G. Dunn (2002) Industrial Microbiology. Publ. Agrobios. India Jodhpur.
8. Ratledge. C. and B. Kristiansen. (2001) Basic Biotechnology 2ndEdn. Cambrige University Press .
9. Schmauder. H.P.; M Schweizer. (1997) Methods in Biotechnology. Taylor and Francis publisher.
10. Stanbury; P.F. and A. Whitaker (1984) Principles of fermentation Technology. Pergamon. New York.
11. Trehan. K. (1990). Biotechnology. New Age International New Delhi..
12. Borem A. Santos R. and D.E. Bowen (1998) Understanding Biotechnology.

BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology(CBCS -2018 COURSE)

Semester-II

PGMB 202ANALYTICAL TECHNIQUES

Total Credits: 04 **Total Lectures:60**

UNITI. RADIOACTIVE ISOTOPES& THEIR USE 10

1. Radioactive decay.
2. Measuring radioactivity.
3. Autoradiography.
4. Biological applications.
5. Working practices when using radioactive isotopes.
6. Safety and procedural aspects.

UNITII. CENTRIFUGATION. 10

1. How to calculate centrifugal acceleration.
2. Centrifugal separation methods.
3. Types of centrifuge and their uses.
4. Rotors.
5. Centrifuge tubes.
6. Safe practice.

UNITIII. CHROMATOGRAPHY. 14

1. Types of chromatographic systems.
2. Separation methods.
3. Detectors.
4. Recording & Interpreting chromatograms.

UNITIV. ELECTROPHORESIS. 12

1. Basic apparatus.
2. Using a supporting medium.
3. Types of supporting media.
4. Post electrophoretic procedures.

UNITV. SPECTROPHOTOMETER. 14

1. Principles.
2. UV spectrophotometer
3. Visible spectrophotometer

4. Fluorescence spectrophotometer.
5. Atomic spectroscopy.

Literature Cited

1. Boyer. R. (2000) Modern Experimental Biochemistry. 3rd Edition. Pearson Education Asia.
2. Lehninger. A.L. (1984) Principles of Biochemistry.
3. Mathews C.K. and K.E. Van Holde (1996) Biochemistry. The Benjamin Cunnings publishing Co. Inc. 2nd Edition.
4. Pattabiraman T.N. (1993) Principles of Biochemistry Gajanan Publisher.
5. Reed, R; Homes, D; Weyers, J. and A. Jones. Practical skills in Biomelecular Sciences. Addison Wesley Longman Limited.
6. Satyanarayana (1999) Biochemistry. Books & Allied (p) Ltd.
7. Wilson and Walker (2000) 5th edition Practical Biochemistry principles and techniques, Cambridge Univ. Press

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BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology (CBCS-2018 COURSE)

Semester II

PGMB 203: QUANTITATIVE BIOLOGY

Total Credits: 04 **Total Lectures:60**

UNIT I BIOSTATISTICS **16**

1. Introduction -

- What is statistics- Definition, population & universe, sample &population? Statistical inference, Parameter & Statistics Designing simple experiments, Arithmetic mean and Standard deviation.

2. Handling of Bulky data

- Construction and interpretation of a Histogram, Normal distribution.Estimating the mean and standard deviation of a large sample, representing normal curve as a straight line, Uncertainties in estimating a mean.

3. Proportion data :

- Examples of proportion data (MPN, Sterility testing of medicines, animal toxicity, therapeutic trials of drug and vaccines, animal toxicity, infection and immunization studies eg LD50, ED50, PD50), Statistical treatment of proportion data, Chi-Square test, goodness offit to normal distribution.

4. Count data :

- **Examples of count data:** Bacterial Cell count, radioactivity count, colony and plaque count etc.
- **Statistical treatment to count data:**Poison distribution, standard error, confidence limits of count .

5. Analysis of variance :

- Introduction, procedure,
- F & T test.

6.Correlation regression & line fitting through graph points :

- Standard curve, correlation, linear, regression. (Fitting the best straight through the series of Points), Standard curves &interpolation of unknown Y value.

7.Statistical basis of biological assays:

- Standard line interpolation assay, parallel line assay (4 point,6point assay) slope ratio assay.

UNITII MENDELIAN GENETICS 16

1. Monohybrid crosses and Mendel's principle of segregation.
2. Dihybrid crosses and Mendelian principle of independent assortment.
3. Statistical analysis of Genetic data. The chi-square test.
4. Multiple alleles – ABO blood groups.
5. Modification of Dominance relationships.
6. Gene interactions and modified Mendelian ratios.
7. Essential genes and lethal genes.
8. The environment and gene expression.

UNITIII POPULATION GENETICS 16

1. Difference in genotype frequencies amongst population. Hardy – Weinberg principle.
2. Random mating.
3. Polymorphic genes and DNA typing.
4. Inbreeding.
5. Genetic change in species leads to evolution.
6. Introduction of new alleles in population.
7. Natural selection.
8. Random changes in allele frequency.

UNITIV PROBLEM SOLVING 12

Literature Cited

1. Bailey N.T.J (1995) Statistical Methods in biology 3rd Edition. Cambridge lowprice Edition Cambridge university press.
2. Dixit J.V. (1996) Principles & Practice of Biostactistics 1stEdn. M/s. BanarasidasBhanot (Publisher).
3. Frank H. Stephenson (2003) Calculations for Molecular Biology and Biotechnology. A guide to Mathematics in the laboratory Academic Press an imprint of Elservier.
4. Gardner E.J., Simmons, M.J and D.P. Snustad. (1991) Principles of Genetics. 8th Edition. John Willey & Sons. Inc.
5. Hartl. D.L. and E.W. Jones. (1999) Essential Genetics. Second Edition. Jones and Bartlett Publisher.
6. Irwin H. Segel (1976) Biochemical Calculations 2nd Edition John Viley& Sons.
7. Khan And Khanum
8. Pranab Kr. Banerjee (2006) Problems on Genetics, Molecular Genetics and Evolutionary Genetics. New Central Book Agency (P) Ltd. Kolkata.
9. Pierce.B.A, (2005) Genetics A Conceptual Approach.2ndEdition.W.H.Freeman and Company,New York

10. Russel. P. (1998) Genetics Fifth edition. Addison. Wesley Longman Inc.
11. Snyder. L. and W. Champress. (1997) Molecular Genetics of Bacteria. ASM Press. Washington. D.C.
12. T. Bhaskararao (2002) Methods of Biostatistics. Paras Publishing.
13. Wardlaw A.C. (1985) Practical statistics for experimental Biologists John Wiley & Sons. Ltd.

BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology(CBCS2018 COURSE)

SEMESTER-II

PGMB 204: MICROBIAL METABOLISM

Total Credits: 04 **Total Lectures:60**

UNITI INTRODUCTION TO METABOLISM. 05

1. Catabolism
2. Anabolism
3. Types of metabolic reactions
4. Methods employed to study metabolism.
5. Metabolic control mechanisms.Control of enzyme levels.
   - Control of enzyme activity.
   - Compartmentation.
   - Hormonal regulation.

UNIT II BIOENERGETIC CONSIDERATIONS. 08

1. Membrane Potential
   - Generation & maintenance.
   - Energetics of proton motive force.
2. Oxidation as a Metabolic enzyme source –
   - Biological oxidations.
   - Reductions.
   - Oxidation -
     a. Reduction potentials and standard electrode potential.
     b. Redox couple.
     c. Nernst equation.
   - High energy compounds – ATP, GTP, CTP, PEP, NAD, NADP, FAD, FMN.
   - Hormonal regulation.

UNIT III AEROBIC RESPIRATION 08

1. Bacterial Electron transport chain
2. Mitochondrial ETC –
   - Structure of mitochondria
   - Mitochondrial ETC
   - Shuttle systems across mitochondrial membrane.
   - Citric acid cycle and oxidative phosphorylation.

UNIT IV ANAEROBIC RESPIRATION 05

1. Concept.
2. Sulfur Compounds, Nitrate & CO_2 as electron acceptors.
3. ETC in SO_4 reducers and NO_3 reducers.

UNITV CARBOHYDRATE METABOLISM: (Major pathways of carbohydrate metabolism) 15

1. Concept of fermentation with respect to -
   - Homo &heterolactic, bacteria.
   - Saccharolytic*Clostridia* &proteolytic*Clostridia*.
   - Enzymes, intermediates, cofactors & regulation of glycolysis.
   - Gluconeogenesis.
   - HMP pathway.
   - ED pathway.
   - TCA cycle &glyoxylate bypass.
2. Metobolism of –
   - Starch.
   - Glycogen.

UNIT VI METABOLISM OF LIPIDS 10

3. Fatty acid oxidation – stages and tissues.
4. Oxidation of odd carbon chain fatty acid.
5. Oxidation of unsaturated fatty acids –
   - Alpha (α)
   - Beta (β)
   - Omega (ω).

4.Biosynthesis of fatty acids.
5.Synthesis of Triacylglycerols.
6.Metabolism of phospholipids.

UNITVII NUCLEIC ACID METABOLISM 09

1. Synthesis and Catabolism of purines and pyrimidines – *De novo*biosynthesis.
2. Regulation of steps.
3. Purine degradation and clinical disorders of purine metabolism.
4. Pyrimidine metabolism.
5. Deoxyribonucleotide biosynthesis and metabolism.

6. Inhibitors of nucleotide biosynthesis.

Literature Cited

1. Agarwal G.R., Agarwal O. P. Agarwal K. Text book of Biochemistry, Goel publishing house Meerut, 8th Edition 1995.
2. Conn, E.E. P.K. Stumpf, G. Bruening and R.H. Dol. (1995). Outlines of Biochemistry. 5th Edition John Wiley and Sons.
3. Doelle, H.M. (1975), "Bacterial metabolism". Academic Press Inc. Ltd. London.
4. Foster. R.L. (1980) The Nature of Enzymology Croon Helm Ltd. London.
5. Kachel. P. W. & G. B. Ralstion (2003) Schaum'southlines. Biochemistry – II Edition. Tata McGraw Hill Edition.
6. Lehininger. A. L; Nelson, M. M. Cox (1992) Principles of Biochemistry 2nd Edition, CBS Publishers and Distributors.
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BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology (CBCS- 2018 COURSE)

SEMESTER –II

PGMB-205 PHYSIOLOGY AND METABOLISM

Total Credits: 04 **Total Lectures:60**

UNIT ISTRUCTURE AND FUNCTIONS OF PROTEIN 15

1. Protein Structure

- Factors determining protein structure
- Tertiary structure of globular proteins and functionaldiversity
- Dynamics of globular protein structure
- Methods of protein detection Dicroism (CD) Nuclear Magnetic Resonance (NMR), X-ray crystallography.

2. Protein Funtion and evolution

- Actin– Myosin**,** structure of muscle,mechanism of mocontraction, role of calcium
- Microtubule system
- Oxygen Transport-Haemoglobin
- Changes in haemoglobin structure on oxygen binding
- Haemoglobinvarients
- Evolution of Haemoglobin and Myoglobin

3.The diversity of enzymatic function

- Protein enzymes
- Non prorein enzyme
- The regulation of enzyme activity- substrate level,feed back control,
- Allosteric enzymes -

UNIT II VITAMINS–OCCURRENCE, STRUCTURE AND BIOCHEMICAL FUNCTION 08

1. Water soluble vitamins.
2. Fat solublevitamins.

UNITIII PHOTOSYNTHESIS 08

1. Energy considerations of photosynthesis.
2. Light energy and photolysis of water.
3. Photo chemical centers.
4. Uphill flow of electrons.
5. Electron carriers in photosynthesis.
6. Cyclic photophosphorylation – Light reaction.
7. Non cyclic photophosphorylation.
8. Regulatory aspects of photosynthesis.
9. Dark reactions – The Calvin cycle
10. Photosynthesis –
    - C_3, C_4, & CAM plants.
    - Photorespiration.

UNIT IVLIPIDS METABOLISM AND PHYSIOLOGICAL FUNCTION 16

1. **Steroid metabolism**
    - Structure of steroids
    - Biosynthesis of cholesterol
    - Bile acids
    - Other isoprenoid compounds

2. **Eicosanoid metabolism**
    - Structure
    - Biosynthesis and catabolism
    - Biological action
3. **Phospholipid metabolism**
    - Structure
    - Biosynthesis of phospholipids in bacteria
    - Glycerophospholipid metabolism in eukaryotes.

4. **Hormones in regulation of metabolism.**
    - Classification of hormones –
        a. Based on the chemical nature.
        b. Based on mechanism of action.
    - Mechanism of hormone action –
        a. Synthesis.
        b. Signal transduction.
        c. Steroid and thyroid hormones.
        d. Endocrine glands & their secretion.

UNITVMETABOLISM OF NITROGENOUS COMPOUND 06 (AMINO ACIDS, NEUROTRANSMITTERS)

1. Nitrogen metabolism –Glutamate dehydrogenase, Glutamate synthase & glutamine synthetase.
    - Biosynthesis and regulation of amino acids.
    - Catabolism of amino acids.
2. Amino acids related to citric acid cycle.
3. Amino acids and their metabolites as Neurotransmitters and biological regulators.

UNITVI Tools in Biochemistry 07

Literature Cited

1. Agarwal G.R., Agarwal O. P. Agarwal K. Text book of Biochemistry, Goel publishing house Meerut, 8th Edition 1995.
2. Conn, E.E. P.K. Stumpf, G. Bruening and R.H. Dol. (1995). Outlines of Biochemistry. 5th Edition John Wiley and Sons.
3. Doelle, H.M. (1975), "Bacterial metabolism". Academic Press Inc. Ltd. London.
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12. Stanier. R.Y. J.N. Ingraham, M.L. Wheelis& P.R. Painter (1995) – General Microbiology, 5th Ed. Mac Millan Press Ltd.
13. Stryer L – (1995) Biochemistry, 4th Edition W.H. Freeman & Company New York.
14. Subbarao N.S. (1979), Recent advances in biological nitrogen fixation: Oxford & IBH Publishing Co. Private Ltd. New Delhi.

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BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology(CBCS-2018 COURSE)

SEMESTER II

PGMB211-PRACTICAL COURSE-3

Total Credits: 02 **Total Lectures:120**

1. Biostatistics: **12P**
    - Mean, mode, median.
    - Variance & correlation.
    - T – Test, F-Test. r^2 test.
    - Use of computers in Biostatistical analysis.

2. Fermentor design **1P**

3. Production of citric acid by surface and submerged culture. **2P**

4. Production of ethanol by shake flask culture and in fermentor **2P**

5. Enzymes – Enzyme purification. **1P**
    - Ammonium sulfate precipitation.
    - Organic solvent precipitation.
    - Gel filtration.

6. Determination of Km and Vmax values of Invertase and amylase. **2P**

7. Spectrophotometric analysis of nucleic acid and protein **2P**

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22 P

Literature Cited

1. Bailey N.T.J. (1995) Statistical Methods in Biology 3rd Edition. Cambridge lowprice Edition Cambridge university press.
2. Dixit J.V. (1996) Principles & Practice of Biostactistics 1stEdn. M/s. BanarasidasBhanot (Publisher).

3. Frank H. Stephenson (2003) Calculations for Molecular Biology and Biotechnology. A guide to Mathematics in the laboratory Academic Press an imprint of Elservie
4. Goldsby R.A. Kindt. T.S. and B.A. Osborne (2000) Kuby Immunology Fourth Edition W.H. Freeman & Co New York.
5. Khan And Khanum, (2008), Fundamentals of Biostatistics, 3rd Revised Edition, Ukaaz Publication, Hyderabad.
6. Reed R, Holmes; D; Weyers. J & A Jones (1998) Practical skills in Biomolecular sciences. Adison Wesley Longman Ltd.
7. Stanbury; P.F. and A. Whitaker (1984) Principles of fermentation Technology. Pergamon. New York

8 T. Bhaskararao (2002) Methods of Biostatistics.Paras Publishing.

9 Wardlaw A.C. (1985) Practical Statistics for experimental Biologists JohnWiley&Sonhs. Ltd

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BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology(CBCS- 2018 COURSE)

SEMESTER II

PGMB212-PRACTICAL COURSE-4

Total Credits: 02 **Total Lectures:120**

1. Calculation of Mendelian Ratios **2 P**
2. Statistical analysis of Genetic data. **2P**
3. Problems on Hardy – Weinberg principle **2P**
4. Determination of vitamin C/A/B2 in natural sources **2P**
5. Measurement of activity NAD dependant enzymes **2P**
6. Isolation of nucleic acid and characterization by gel Electrophoresis **2P**
7. Recombination in bacteria – Preparation of competent cells and transformation of plasmid DNA in *E. coli*. **2P**
8. Conjugation in bacteria. **2P**
9. Plasmid curing using different agents **2P**
10. Protoplast fusion **1P**
11. Determination of mutation rate – natural and induced

12. Gene Cloning – Demonstration

3 P

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22 P

Literature Cited

1. Frank H. Stephenson (2003) Calculations for Molecular Biology and Biotechnology. A guide to Mathematics in the laboratory Academic Press an imprint of Elservier.
2. Gardner E.J., Simmons, M.J and D.P. Snustad. (1991) Principles of Genetics. 8th Edition. John Willey & Sons. Inc.
3. Hartl. D.L. and E.W. Jones. (1999) Essential Genetics. Second Edition. Jones and Bartlett Publisher.
4. Irwin H. Segel (1976) Biochemical Calculations 2nd Edition John Viley& Sons.
5. Lewin B. (2004) Genes VIII – International Edition. Pearson. Prentice Hall. Pearson Education International
6. Pierce.B.A, (2005) Genetics A Conceptual Approach.2ndEdition.W.H.Freeman and Company,New York
7. Pranab Kr. Banerjee (2006) Problems on Genetics, Molecular Genetics and Evolutionary Genetics. New Central Book Agency (P) Ltd. Kolkata.
8. Primrose. S.B. and R.M. Twyman and R.W. Old (2003). Principles of Gene Manipulation. 6thEdn. Blackwell Science.
9. Reed, R; Homes, D; Weyers, J. and A. Jones. Practical skills in Biomelecular Sciences. Addison Wesley Longman Limited
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11. Sambrook. J and D.W. Russel. (2001) Molecular cloning. A Laboratory Manual. 3rdEdn. Vol. 1,2,3. Cold Spring Harbor laboratory Press..
12. Snyder. L. and W. Champress. (1997) Molecular Genetics of Bacteria.
    a. ASM Press. Washington. D.C.
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2004) Molecular Biology of the Gene.5thEdn.Low Price edition. Pearson

BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology(CBCS- 2018 ABILITY ENHANCEMENT COURSE)

SEMESTER II

PGAEC 201SCIENTIFIC WRITING

Total Credits: 02 **Total Lectures:30**

UNITI. SCIENTIFIC WRITING

1. **General aspects:** **4**
   Organising time, Organizing information and ideas eg. writing - adopting a scientific style, Developing technique, Getting Started Revising your text with the help of words and phrases, sentences, paragraphs, using dictionaries, using a thesaurus, using guides for written English.
2. **Review writing:** **4**
   Organizing time, making a plan Construct possible content and examples, construct an outline, Start writing, Reviewing your write-up.

3. **Reporting practical and project work:** **6**
   Practical & project reports Thesis Structure of reports of experiment works - Title, Authors & their institution, Abstract Summary, List of Contents. Abbreviations, Introduction, Materials and Methods Results Discussion / conclusions, Acknowledgements, Literature cited (Bibliography) Production of a practical report choose the experiment, make up plants, write, Revise, prepare final version. Submit Producing a Scientific paper Assessing potential content, choosing a

journal, writing, submitting. Responding to referees comments checking proofs & waiting for publication.

4. **Writing literature surveys:** **5**
   Selecting a topic Scanning the literature and organizing references, Deciding on Structure and content Introduction, Main body of the text, conclusion, References, Style of literature surveys.

5. **Organizing a poster display:** **5**
   Preliminaries, Design, Layout, Title Text, Sub titles and headings, ColourContent.Introduction, Materials and Methods, Results and conslusion.The poster session.

6. **Giving an oral presentation.** **4**
   - Preparation - Preliminary information, Audio - Visual aids, Audience. Content - Introductory remarks, the main message. Concluding remarks on presentation.

7. **Writing research paper:** **2**
   - Title, Authors and address, Abstract, Key words, Introduction, Materials and Methods, Results& Discussion / conclusions, Acknowledgements, Literature cited (Bibliography)

Literature Cited

1. Day Robert A. : How to write and publish a scientific paper.
2. Gibaldi Joseph: MLA handbook for Writers of Research Papers.
3. Kothari R. C. : Research Methodology, Methods and Techniques, 2nd revised edition, New Age International.
4. Ranjit Kumar: Research Methodology.
5. Reed, R. Homes, D; Weyers, J. and A. Jones. Practical skills in Bimolecular Sciences. Addison Wesley Longman Limited
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17. Irwin H. Segel (1976) Biochemical Calculations 2nd Edition John Viley& Sons.
18. Khan And Khanum, (2008), Fundamentals of Biostatistics, 3rd Revised Edition, Ukaaz Publication, Hyderabad.
19. Khan ImtiazAlam : Elementary Bioinformatics, Pharma Book Syndicate.
20. Kothari R. C. : Research Methodology, Methods and Techniques, 2nd revised edition, New Age International.
21. Prescott. S.C. and C.G. Dunn (2002) Industrial Microbiology. Publ. Agrobios. India Jodhpur
22. Ranjit Kumar: Research Methodology.
23. Reed, R. Homes, D; Weyers, J. and A. Jones. Practical skills in Bimolecular Sciences. Addison Wesley Longman Limited.
24. Simpson R.J. (2004) Purifying Proteins for Proteomics. A laboratory Manual. Cold spring Harbor laboratory press.
25. Sneath, P.H.A. Mair : N. S. Sharpe : M.E. and J. G. Holt (Eds) (1986), Bergey's Manual of Systematic bacteriology Vol. II Williams and Wilkins, Baltimore, London, Tokyo.
26. T. Bhaskararao (2002) Methods of Biostatistics. Paras Publishing.
27. Wardlaw A.C. (1985) Practical statistics for experimental Biologists John Wiley & Sons. Ltd.
28. Wayne Daniel: Biostatistics - A Foundation for Analysis of Health Sciences, John Wiley and Sons, Inc.
29. Wayne Goddard and Stuart Melville: Research methodology – An Introduction.
30. Westhead. D.R.,.Parish J.H and R.M. Twyman (2003) Instant notes in 'Bioinformatics' Viva Books Private Ltd.

31.

BHARATI VIDYAPEETH

DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology

SEMESTER –IV

PGMB 401 :VIROLOGY (CBCS- 2018 COURSE)

Total Credits: 4 **Total Lectures:60**

UNIT I. INTRODUCTORY VIROLOGY 10

1. Morphological types of viral capsids: Icosahedral, Helical and Complex
2. Types of viral nucleic acids with representative examples
3. Viral replication cycles:
   - Lytic cycle,
   - Lysogeny

UNIT II TECHNIQUES IN CULTIVATING VIRUSES 12

1. 'Embryonated Egg Technique'
2. Tissue culture techniques with merits and demerits:
   -Primary cell cultures
   -Diploid cell cultures
   -Continuous cell cultures
3. The science and art of making viral vaccines:
   -Inactivated or "killed" virus vaccines
   -Attenuated Virus Vaccines
   -Subunit Virus Vaccines
   - Recombinant DNA approaches to Subunit vaccines
   -Virus Like Particles
   -DNA Vaccines
   -Attenuated Viral Vectors and Foreign Gene Expression

4. Vaccine technology for Delivery and Improving Antigenicity
   -Adjuvants
   -Delivery and formulation
   -Immunotherapy

UNIT III. BACTERIOPHAGES 10

1. Morphology, genome organization and life cycle of :
   -T-even, T-odd, coliphages, λ phage Mu-1.
2. Phage Bacterium interaction / phage Biology
3. Genome mapping- T_4R II locus, Benzor's Spot Test, Complementation test
4. Viruses that kill superbug (ESKAPE Therapy)

UNITIV. ANIMAL VIRUSES 08

1. Reproduction of animal viruses:
   - i) Adsorption of virions
   - ii) Penetration and uncoating
   - iii) Replication and transcriptions in DNA viruses
   - iv) Replication and transcriptions in RNA viruses
   - v) Synthesis and assembly of virus capsids
   - vi) Virion Release
2. Cytocidal infections and cell damage.
3. Intrinsic Response to animal viral infections:
   -Programmed Cell Death (Apoptosis)

UNITV PLANT VIRUSES 08

1) Effect of viruses on plants
2) Plant virus reproduction: Tobacco Mosaic Virus (TMV)
3) Transmission of Plant Infecting Viruses- with vectors and without vectors

UNITVI. UNUSUAL INFECTIOUS AGENTS 12

1)Viroids
- i) Replication
- ii) Sequence diversity
- iii) Movement
- iv) Pathogenesis

2) Satellites
- i)Replication
- ii) Pathogenesis

3) Prions and transmissible spongiform encephalopathies
- i) Scrapie
- ii) Creutzfeldt-Jakob disease (CJD)
- iii) Prions and the *prnp* gene

Literature Cited

1. Black J.G. (2002) Microbiology Principles and Explorations – 'Viruses' 255 – 283. 5thEdn. John wiley& sons Inc.
2. Darnell J.E. avid Baltimore , Allan Campbell, General Virology
3. Dimmock N.J. , A.J.Easton and K.N.Leppsrd, " Introduction to Modern Virology" Fifth edition, Blackwell Science (Topic B)
4. Flint S.J., L.W.Enquist, R.M.Krug, V.R.Racaniello, A.M. Skalka (2000) Principals of Virology, Molecular Biology Pathologeneis and Control ASM Press.
5. Lewin B. (2000) Genes VII. Oncogenes &Cancer 875-913. Oxford University Press.
6. Mattew K. Waldor , David I. Friedman and Sankar L. Adhya (2005) Phages : Their role in Bacterial Pathogenesis and Biotechnology, ASM Press , Washington DC

7. McKane. L. and KJ.Kandel. (1996) Microbiology Essentials and Applications. Viruses – pg. 305-332 McGrawtlill Inc.
8. Packer. M. (1983) Veterinary Bacteriology and Virology. 7th Edition CBS Publisher.
9. Rangaswami G & D.J. Baygyaraj. (1993) Agriculture Microbiology, 2ndEdn. Viral diseases of plants – 313-323.
10. Talaro. K.P and A. Talaro. (2002) Foundation in Microbiology. 4th Edition. An introduction to viruses. 159 – 185. McGraw Hill.

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BHARATI VIDYAPEETH

DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology (CBCS-2018 COURSE)

SEMESTER –IV

PGMB 402–MEDICAL MICROBIOLOGY

Total Credits: 4 **Total Lectures:60**

UNITI. MICROBIAL ADHESION AND INVASION 15

1. Role of sulfatide receptors in the pathogenesis of *Mycoplasma*
2. Significance of Ganglio and Lacto series glycolipids in pulmonary infections.
3. Molecular interactions between 'Human Rhinoviruses and 'ICSM-1'
4. Role of Heparin sulfate Glycosaminoglycans in the spread of Herpes simplex virus.
5. Interactions of Poliovirus with immunoglobulin like cell receptor.
6. Mycolic Acid based invasion,(*Mycobacteria*)
7. Quorum Sensing

UNITII. INFECTIOUS DISEASE SYNDROMES 11

1. Bacteremia
2. Sepsis
3. Pathophysiology of septic shock
4. Vascular damage and peripheral vasodilation
5. Infective endocarditis
6. Pyrexia
7. Centrally distributed maculopapular eruptions
8. Peripheral eruptions
9. Vesicular eruptions
10. Purpuric eruptions

UNITIII. DETAILED STUDY OF FOLLOWING DISEASES 30

1. Tuberculosis
2. Gonorrhoea
3. Syphilis
4. Bacillary Dysentry
5. Cholera
6. Herpes
7. Hepatitis A and B
8. Influenza
9. Dengue
10. Chikungunya
11. Systemic candidiasis
12. Invasive aspergillosis
13. Malaria
14. Amoebiasis
15. Nosocomial infections: *Staphylococcus* and *Pseudomonas*

UNITIV. CONTROL OF INFECTIONS IN HOSPITALS 04

1. Nursing Precautions
2. Isolation Policies
3. Hospital acquired infections
4. Prevention of surgical wound infections and burn infections.

Literature Cited

1. Ananthanarayan R., C.K.JayramPaniker, " Textbook of Microbiology" 8th Edition , Orient Longman Pvt.Ltd. (Topic C)
2. Collee J.G., J.P.Duguid, A.G.Fraser, B.P.Marmion, "Practical Medical Microbiology" Thirteenth edition, Churchill Livingstone (Topic C)
3. Dimmock N.J. , A.J.Easton and K.N.Leppsrd, " Introduction to Modern Virology" Fifth edition, Blackwell Science (Topic B)
4. Flint S.J., L.W.Enquist, R.M.Krug, V.R.Racaniello, A.M. Skalka (2000) Principals of Virology, Molecular Biology Pathologeneis and Control ASM Press.
5. King Maurice, " A Medical Laboratory for developing countries" First Edition, Oxford University Press (Topic D)
6. Magnus Hook, Lech Switalski, Microbial Adhesion and Invasial, First Edition, Springer – Verlag New Yark Inc. (Topic A)
7. Matthew K Waldor, David J Friedman and Sankar L. Adhya, "Phages" 2005, American Society for Microbiology Press (Topic A)
8. Saravanan P., Virology, MJP Publishers Chennai. (Topic C)
9. Sharma B., 'Medical Microbiology' A Clinical Perspective' First edition 2001, Paras Medicla Publishers Hydrabad (Topic D)
   'Principles of Virology' 2000, American Society for Microbiology Press (Topic C)

BHARATI VIDYAPEETH

DEEMEDUNIVERSITY, PUNE

M.Sc. Microbiology (CBCS- 2018 COURSE)

SEMESTER –IV

PGMB 403: FOOD AND DAIRY MICROBIOLOGY

Total Credits: 4 **Total Lectures:60**

UNITI FOOD MICROBIOLOGY **12**

1. **Food borne pathogens.**
   - Bacterial pathogens: *Salmonella, Shigella, E.coli., Staph.aureus.Clostridium botulinum*
   - Toxigenic molds: *Aspergillus*spp.
     - Detection and identification of Aflatoxins,
     - Viruses: Hepatitis, mechanism of pathogenesis, characteristics of disease, stablityin foods, outbreaks.
   - Parasites (different examples) ,*Entamoebahistolytica*
2. **Fermented food products** **08**
   - Fermented vegetables.
   - Fermented meat, poultry and fish.
   - Traditional Fermented foods.
   - Wine.

UNIT II DAIRY MICROBIOLOGY **06**

1.Milk and milk processing.

- Milk composition and components.
- Milk processing. Different processes to manufacture products from milk.
- Changes in milk components during processing.

2.The Microbiology of Raw milk. **08**

- Initial microflora of raw milk.
- Milk and public health, safeguarding milk supply.
- Biosecurity, Udder disease and bacterial content of Raw milk.
- Environmental sources.
- Microflora of milking equipment and its effect on raw milk.
- Influence of storage and transport on the microflora of raw milk.

3. Microbiology of market milks. 0**8**
   - Market milk industry in India.
   - Indian Standards
   - Composition, Factors affecting composition, Food and Nutritive value.
   - Current heat treatments.
   - The microflora and Enzymatic Activity of heat-treated market milks – Influence on Quality and shelf life.

- Manufacture, Packaging and storage of pasturised milk.
- Pathogenic microorganisms associated with heat-treated market milks.
- Influence of added Ingredients.
- Potential Application of Alternative to heat for market milks.
- Flavor Defects in milk- causes and prevention.

4. Fermented milk products 06

- Special milks- Sterilised milk, Homogenised milk, Flavored milk, and frozen concentrated milk.
- Cream.
- Butter.
- Indian dairy products-Whole Milk, Dahi, Paneer

UNIT III PROBIOTICS 12

1. Probiotic microorganisms associated with therapeutic properties.
2. Criteria associated with probiotic microorganisms.
3. Safety of issues associated with use of Probiotic cultures for Humans.
4. Beneficial health effects of Probiotic cultures.
5. Effective daily intake of Probiotics.
6. Probiotic dairy products.
7. Factors affecting Probiotic survival in food Systems.

Literature Cited

1. Banwart. G.J. (1987) Basic Food Microbiology CBS Publishers and distributors.
2. Barnum. S.R. (1998) Biotechnology: An introduction. Wadsworth Publishing company. An International Thomson Publishing company.
3. Davis. J.G. (2002) Milk Testing. Agrobios – India. Jodhpur.
4. De. S. (980) Outlines of Dairy Technology. Oxford University Press.
5. Doyle M.P. Beychat. L.R. and T.J" Montville (1997) Food Microbiology Fundmentals and Frontiers. ASM Press. Washington D.C.
6. Frazier. W.C. and D.C. Westhoff. (1988). Food Microbiology. 4thEdn. Tata McGraw Hill. Publ. Co. Ltd.
7. Jay. J.M. (1986) Modern Food Microbiology 3rd Ed. CBS Publishers and Distributors.
8. Kinson. T.A. and R.F. Sherwook. Biotech Handbooks & series (1995). Eds. Larry Barton. Plenum Press New York.
9. Rajvaidya N. and D.K.Markandey. (2004) Applied Microbiology. Vol. 1-5 APH Publishing Corp. New Delhi.
10. Robinson R.K. (2002) Dairy Microbiology Handbook: The Microbiology of milk and milk products. :Publ: Wiley Interscience. A John Wiley & Sons. Inc. Publication.
11. Versalovic James and Wilson Michael (2008) Therapeuti Microbiology Probiotics and Related Strategies, ASM Press, Washington, DC.
12. Winton and Winton. (2002) milk and milk Products Agrobios India, Jodhpur.

BHARATI VIDYAPEETH

DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology (CBCS- 2018 COURSE)

SEMESTER –IV

MB- 404 ADVANCED BIOTECHNOLOGY

Total Credits: 4 **Total Lectures:60**

UNIT I PLANT BIOITECHNOLOGY TECHNIQUES AND APPLICATIONS 20

1. Plant tissue culture laboratory design
2. Plant tissue culture and applications.
    - Micropropagation.
    - From callus to plant.
    - Somatic embryogenesis &synseeds
    - Somaclonal variation.
    - Valuable germplasm.
    - Chemicals from plants and techniques for study of - Hairy root, Elicitation, Biotransformation,
    - Bioreactor in PTC/ Fermentor in PTC.
3. Methods for gene transfer / Formation of transgenic plants
4. Applications of plant genetic engineering.
    - Crop improvement.
    - Herbicide resistance.
    - Insect resistance.
    - Virus resistance.
    - Plants as Bioreactors.
    - The first genetically engineered food plants.
    - Frost resistant plants
    - Fruit Vaccine.

UNITII ANIMAL BIOTECHNOLOGY TECHNIQUES AND APPLICATIONS 20

1. Types of cell cultures –
    i. Primary , secondary
    ii. Continuous,established cell lines
    iii. Monolayer ,suspension cell cultures

2. Cell culture media:
    i. Nutrient requirements,
    ii. Media constituents, types of media, growth conditions, etc.

3. Culture techniques:
    i. Culturing, subculturing, establishment,
    ii. Maintenance and preservation of cell lines
    iii. Quantification- Cell counting, Plating efficiency, Growth curve.

iv. Cytotoxicity
v. Organotypic culture.
vi. Molecular Techniques in cell culture
- Gene transfer methods in animals:
- Microinjection.
- Microprojectile Gene Gun
- Embryonic stem cell Gene Transfer.
- Retrovirus and Gene transfer.
- Cell hybridization
- Monoclonal antibody production

5. Applications of ATC
   - Transgenic animals.
   - Animal propagation.

UNITIII MARINE BIOTECHNOLOGY 10

1. Aquaculture.
2. Algal products.
3. Algal cell culture.
4. Fuels from algae.
5. Medical applications.
6. Probing the marine environment.
7. Conservation.
8. Terrestrial agriculture.
9. Transgenic fish.

UNITIV CLINICAL DEVELOPMENT OF BIOLOGICAL PRODUCTS 05

1. Regulatory authorities for introduction of medicines in market- Role of food and drug administration, FDA guidelines for drugs/biologicals, Validation (GMP, GLP, GCP, etc.).
2. Clinical studies: Phase I, Phase II, Phase III, and Phase IV of clinical trials- Objectives, Conduct of trials, Outcome of trials.
3. Delivery systems- formulations, targeted drug delivery, sustained release drugs

UNIT V REGULATIONS, PATENT AND SOCIETY. 05

1. The deliberate release of Genetically engineered organisms.EPA Guidelines
2. Risk assessment.
3. Patents and Biotechnology.
4. IPR & Ethical issues
5. Sustainable Biotechnology.
6. Biosafety Guidelines

Literature cited

1. Barnum. S.R. (1998) Biotechnology: An introduction. Wadsworth Publishing company. An International Thomson Publishing company.
2. Borem A. Santos R. and D.E. Bowen (1998) Understanding Biotechnology.

3. Casida. L.E. (2003) reprint Industrial Microbiology Publ: New Age International (p) Ltd. New Delhi.
4. Chirikjian J.G. (1995) Biotechnology Theory and Techniques. Vol. I. Plant Biotechnology. Animal cell culture. Immunobiotechnology. Ed. Karen Graf. Edvotex. Ind. Jones and Bartlett. Publishers.
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9. Patel. A.H. (2003 reprint) Industrial Microbiology Publ: Macmillan. India Ltd. New Delhi.
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BHARATI VIDYAPEETH

DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology (CBCS- 2018 COURSE)

SEMESTER –IV

MB 405– ADVANCED ANALYTICAL TECHNIQUES

Total Credits: 4 **Total Lectures:60**

UNITI. ADVANCED SPECTROSCOPY & SPECTROMETRY 06

1. Infrared Spectroscopy
2. Nuclear Magnetic Spectroscopy
3. Calculations

UNITII. ADVANCED ELECTROPHORETIC TECHNIQUES 06

1. Agarose Gel Electrophoresis
2. Matrix SDS-PAGE electrophoresis.
3. Disc Electrophoresis.
4. Capillary Electrophoresis
5. Calculations

UNITIII. ADVANCED CHROMATOGRAPHY TECHNIQUES 06

1. Optimizing chromatographic separations
2. Gas Chromatography
3. High Performance Chromatography, HPTLC.
4. Interfacing GC or HPLC with mass spectrometry
5. Quantitative analysis.

UNITIV ELECTRON MICROSCOPY AND CELL SORTING TECHNIQUES 08

1. Principles, working &applications. Special techniques related to electron microscopy–fixation & staining, Negative staining
2. Freeze etching, shadow casting Scanning, Immunoelectronmicroscopic techniques, Cryo electron Microscopy.
3. Cytophotometry and Flowcytometry.

UNIT V MODERN MICROSCOPIC TECHNIQUES 04

1. Confocal Microscopy, Laser microscopy, Laser scanning microscopy, Atomic force Microscopy.

UNITVI SEQUENCING AND MUTAGENESIS 08

1. Basic DNA sequencing.
2. Whole genome sequencing.
3. Analysing sequence data.
4. Changing genes, site directed mutagenesis

5. RFLP,RAPD,PCR.

UNITVII ADVANCED TECHNIQUES IN FOOD MICROBIOLOGY 08

1. Detecting foodborne pathogens and their toxins conventionalversus Rapid Automated methods.
2. Immonunologic techniques for detecting foodborne pathogens and toxins.
3. Genetic andMetagenomic methods for detection of pathogens.
4. Predictive modeling, Hazard Analysis and critical control system

UNITVIII QUALITY CONTROL IN DAIRY INDUSTRY 10

1. Control of Airborne microorganisms in Dairy Plants.
2. Microbial control of water supplies.
3. Assessment of Dairy equipment hygiene.
4. Sampling of products for microbiological evaluation.
5. Procedures for the direct assessment of the microbial content of milk and milk products.
6. Procedures for the Indirect Assessment of the microbial content of milk and milk products.
7. Methods for determining the shelf life of milk.
8. Sterility Tests.
9. Genetic andMetagenomic method for detecting pathogenic microgranisms and their toxins.
10. Microbiology standards for different dairy products.
11. Relevance of techniques and interpretation of results.

UNIT IX IMMUNOCHEMICAL TECHNIQUES 04

1. Diagnostic Immunohistochemistry
2. Recent techniques

Literature Cited

1. Reed, R; Homes, D; Weyers, J. and A. Jones. Practical skills in Biomelecular Sciences. Addison Wesley Longman Limited.
2. Boyer. R. (2000) Modern Experimental Biochemistry. 3rd Edition. Pearson Education Asia.
3. Mathews C.K. and K.E. Van Holde (1996) Biochemistry. The Benjamin Cunnings publishing Co. Inc. 2nd Edition.
4. Lehninger. A.L. , Devid L, Nelson M, M.Cockes (1992) Principles of Biochemistry " Second Edition" Publisher – CBS Publieshrs
5. Satyanarayana (1999) Biochemistry. Books & Allied (p) Ltd.
6. Pattabiraman T.N. (1993) Principles of Biochemistry Gajanan Publisher.

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BHARATI VIDYAPEETH
DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology (CBCS-2018 COURSE)

SEMESTER : IV

PGSEC401: Exploring Microbial Diversity

Total Credits:2 **Total Lectures:30**

UNIT I. Microbial diversity **4**

1. Definition of species in prokaryotes.
2. Types of 'species' Species Divergence
3. Measures and indices of diversity.

UNIT II Taxonomy **8**

1. Introduction to Bacterial Taxonomy
2. Bergey's Manuals and the classification of prokaryote

. • Determinative Bacteriology :Phenetic Approach
• Systematic Bacteriology : Phylogenetic Approach
•Polyphasic Approach

UNIT III Gene sequencing **12**

1. Outline of gene sequencing procedures
   - Maxam Gilbert's method, Sangers method
   - Automated Sequencer
   - BLAST analysis
   - RFLP
   - RAPD
   - Strategies for whole genome sequencing
   - Whole Genome Shotgun Sequencing
   - Applications of gene sequencing (identification of organisms)

Unit IV :**Unculturable microorganisms** **6**

- Culture independent molecular methods for identifying unculturable bacteria.

References

1. Fakruddin1* and KhanjadaShahnewaj Bin Mannan2eylon C Methods for Analyzing Diversity of Microbial Communities in Natural Environments Md Journal of Science (Bio. Sci.) 42(1): 19-33, 2013 DOI: 10.4038/cjsbs.v42i1.5896 *

2. Breed and Buchanan. Bergey's Manual of Determinative Bacteriology. 9th Edition, 1982.
3. Breed and Buchanan. Bergey's Manual of Systematic Bacteriology. 2nd Edition, (Volumes. 1 – 5) (2001 – 2003). BerguysMannual of Systematics of bacteriology
4. J., Fritsch, E. F. And Maniatis, T. (1989) Molecular Cloning: A laboratory Manual, 2nd ed. Cold Spring harbour NY: Cold Spring Harbour Laboratory Press
5. Sonia R. Vartoukian, Richard M. Palmer & William G. MINIREVIEW Strategies for culture of 'unculturable' bacteria Wade King's College London Dental Institute, Infection Research Group, London, FEMS MicrobiolLett 309 (2010) 1–7 UK DOI:10.1111/j.1574-6968.2010.02000.x
6. Sandy Primrose, Richard Twyman, Bob Old (2001), Principles of Gene Manipulation 6th Edition, Blackwell Science Ltd. 2. Sambrook,

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BHARATI VIDYAPEETH

DEEMED UNIVERSITY, PUNE

M.Sc. Microbiology (CBCS- 2018 COURSE)

SEMESTER –IV

PGMB411- Practical Course 5.

Total Credits: 2 **Total Lectures: 120**

I. Virology:

- Isolation of phages and Study of phage titre 4 P
- Study of plant viruses. 2 P
- Study of animal cell culture 2 P
- Egg inoculation technique for animal viruses. 3 P
- Preparation of animal viral vaccines (Visit) 1 P

II. **Clinical Microbiology**: 4 P

- Isolation of pathogens from wound and burn infections.
- Study of antibiotic resistance pattern of these isolates. 2 P

IIIBiochemistry: 4 P

- Estimation of chlorides, sodium,/ potassium,/calcium /ions in blood

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22 p

Literature Cited

1. Varly H.C. (Fourth Edition) Practical Clinical Biochemistry, CBS Publishers & Distributers Pvt. Ltd, New Delhi, Bangalore, Pune, Cochin, Chennai (Indai), First Indian Edition 1988, reprint : 2002, 2003, 2004, 2005.
2. Ananthanarayan R., C.K.JayramPaniker, " Textbook of Microbiology" 8th Edition , Orient Longman Pvt.Ltd. (Topic C)
3. Collee J.G., J.P.Duguid, A.G.Fraser, B.P.Marmion, "Practical Medical Microbiology" Thirteenth edition, Churchill Livingstone (Topic C)
4. Deb A.C. Comprehensible Viva & Practical (First Pub 1996) Biochemistry (Third Edition : 2005), New Central Book Agency (P) Ltd
5. Dimmock N.J. , A.J.Easton and K.N.Leppsrd, " Introduction to Modern Virology" Fifth edition, Blackwell Science (Topic B)
6. Jayraman – Laboratory manual in Biochemistry, New Age International Publishers, New Delhi
7. Luxton R (2010), Clinical Biochemisrty , 2nd Edition
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M.Sc. Microbiology (CBCS- 2018 COURSE)

SEMESTER –IV

PGMB 412 – Practical Course-6

Total Credits: 2 **Total Lectures: 120**

1.	Isolation and identification of food borne pathogens from food.- *Salmonella/, Shigella/, E.coli/., Staph.aureus.*	4P
2.	Isolation of Aflatoxin producing organism and detection of Aflatoxin.	2 P
3.	Microbial analysis of raw and pasteurized milk.	2 P
4.	Production of gluconic acid by shake flask culture	3 P
5.	Production of Antibiotics like polymyxin /Bacitracin etc**.**	2 P
6.	Preparation of traditional fermented foods e.g. Curd, Idli, Dhoklaetc .	1 P
7.	Study of commercial probiotic products	5 P
8.	Study of plant cell culture	1 P
9.	Mushroom cultivation.	2 P
		22 P

Literature Cited

1. Varly H.C. (Fourth Edition) Practical Clinical Biochemistry, CBS Publishers & Distributers Pvt. Ltd, New Delhi, Bangalore, Pune, Cochin, Chennai (Indai), First Indian Edition 1988, reprint : 2002, 2003, 2004, 2005.
2. Ananthanarayan R., C.K.JayramPaniker, " Textbook of Microbiology" 8th Edition , Orient Longman Pvt.Ltd. (Topic C)
3. Collee J.G., J.P.Duguid, A.G.Fraser, B.P.Marmion, "Practical Medical Microbiology" Thirteenth edition, Churchill Livingstone (Topic C)
4. Deb A.C. Comprehensible Viva & Practical (First Pub 1996) Biochemistry (Third Edition : 2005), New Central Book Agency (P) Ltd
5. Dimmock N.J. , A.J.Easton and K.N.Leppsrd, " Introduction to Modern Virology" Fifth edition, Blackwell Science (Topic B)
6. Jayraman – Laboratory manual in Biochemistry, New Age International Publishers, New Delhi
7. Luxton R (2010), Clinical Biochemisrty , 2nd Edition
8. Mathews C.K. and K.E. Van Holde (1996) Biochemistry. The Benjamin Cunnings publishing Co. Inc. 2nd Edition

9. Nayak S., (2007) ManipalMannual of Clinical Biochemistry, Publisher Jaypees Brother Medical Publisher
10. Plummer D.T, (1992)An introduction to Practical Biochemistry Tata cGraw Hill Publisher,New Delhi